THE

ELECTRICAL REVIEW.

VOL. LIII. JULY 10, 1903. No. 1,337.

"ELECTRICAL REVIEW."

Vol. LIII.] CONTENTS: July 10, 1903. [No. 1,337.

	Page
The Constitution of Atoms	41
The Development of the Current Interrupter (*illus.*) (*continued*)	43
Street Lighting Tests	44
Legal	44
Parliamentary	47
Correspondence	51
The Conduit *v.* the Trolley System	53
Business Notes	54
The Rand Central Electric Works (*illustrated*)	59
Electricity Supply Accounts	67
City Notes	67
Stocks and Shares	70
Share List of Electrical Companies	71
Market Quotations	72
Electric Tramway and Railway Traffic Receipts	72
Metal Market.—Fluctuations in June	73
The Labour and Cost of Tendering	73
Three-Phase Alternators for Bloemfontein (*illustrated*)... ...	74
South African Notes	74
The Engineering Conference :—	
High Speed Electric Traction on Railways (*illustrated*) ...	75
The Electrical Conductivity of Copper (*concluded*)	77
The Erith Tramway Scheme	78
Holiday Traffic on Tramways	79
New Patents Applied For, 1903	80
Published Specifications	80

THE
UNIVERSAL ELECTRICAL DIRECTORY

1903 Edition

Price 10s. Post Free.

H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.
Published every FRIDAY, Price 4d.
The Oldest Weekly Electrical Paper. Established 1872.
TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKKAY, LONDON." Code, A B C.
Telephone No. 933 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS
BY FAR THE LARGEST CIRCULATION
of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street, Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE CONSTITUTION OF ATOMS.

IN his Romanes lecture recently delivered at Oxford, Sir Oliver Lodge expounded some ingenious theories on the constitution of the atom. These theories were intended to give a consistent explanation of the recent remarkable discoveries about electrons and radio-active processes. The lecturer considered that the hypothesis suggested by the observed phenomena was that the atoms of matter are actually composed of these electrons, an equal number of positive and negative charges going to form a neutral atom, and a charged atom having one kind in excess. On this view a stable aggregate of about 700 electrons in violent orbital motion among themselves would constitute a hydrogen atom, 16 times that number would constitute an oxygen atom, and about 150,000 would constitute an atom of radium. "The attractiveness of this hypothesis," says Sir Oliver, "is that it represents a unification of matter, and a reduction of all material substance to a purely electrical phenomenon. The strongest argument in its favour is that mass or inertia can certainly be accounted for electrically, and that there is no other known way of accounting for it."

This is, indeed, a very attractive theory, but it presents many difficulties which appear to be insuperable. An electric charge, it is true, obeys the same law of acceleration as a mass of matter, but we may have positive and negative charges of electricity, while all mass is of the same sign. The 350 positive units of electricity which, together with the 350 negative units of electricity, make up, according to Lodge's theory, the atom of hydrogen, would exactly neutralise each other, and a hydrogen atom constituted in this way would have no mass. We must evidently go deeper than the electric charges on the atoms to get the true explanation of inertia.

An equally attractive, and, we think, equally unsound, hypothesis was put forward by the lecturer to explain radio-active phenomena. Since the atom consists, according to his view, of an aggregate of electrons in violent orbital motion, each of these electrons is undergoing acceleration of direction, and is consequently radiating electric waves into space. It can be shown that this loss of energy will result in an increase of velocity of the revolving electron. When the speed of the electrified body reaches that of light its mass becomes infinite, and in that case a critical condition is reached in which the atom is no longer stable but breaks up into other substances.

It is to be presumed that the masses of the positive and negative electrons which make up the atom, according to Lodge's theory, are equal, since their electric charges are equal. But no positive electron is known with a mass less than about 1,000 times that of the negative electron. The positive fragments thrown off from radium are about equal to this—*i.e.*, about equal to the mass of the hydrogen atom.

The disintegration of the atom gives no proof of the existence of the positive electrons imagined by Sir Oliver Lodge.

The Romanes lecturer appears to favour the view that each atom has a definite length of life, at the end of which it breaks up, or disintegrates. This, indeed, follows from his theory that disintegration is due to the loss of energy by radiation of electric waves. He draws an analogy between the collapse of the atom and the contraction of a nebula, which at certain stages becomes unstable and throws off a planet, the residue constituting an extremely radio-active mass, or sun. But whereas the astronomical changes observed in cosmic configurations of matter occur in a time reckoned in millions of years, the changes to be expected in the more stable atoms would seem likely to require a time reckoned in millions of millions of centuries. Each atom according to this hypothesis has a definite lifetime, and the radio-activity of a substance would be proportional to the death rate of its atoms. With equal length of life, the death rate of atoms would be the same as their birth rate, but Rutherford has shown clearly that radio-activity decays according to a law of geometrical progression—that is, the death rate of the atoms is proportional to the number of the survivors. This does not point to a fixed lifetime for the atom, but rather to the view of J. J. Thomson, that a fixed percentage of the atoms always reach a critical velocity, which determines their disintegration.

Municipality as Contractor.

THE case of the Sheffield Corporation's Omnibus Bill, which came before a Select Committee of the House of Commons recently, is one of considerable interest to electrical contractors, and deserves more attention than it seems likely to receive, thanks to the tactics pursued by its promoters. The Bill, in its original form, contained a clause by which the Corporation sought to legalise the business which it has carried on for some time of wiring and fittings contractor; the old Electric Light and Power Co. had carried on a similar business, the performance of which was included in its articles of association, but was not referred to in the Act confirming its Provisional Order (1892), nor was any reference thereto embodied in the Act confirming the agreement between the Corporation and the company for the purchase of the undertaking by the former. The development of the wiring business dates from the re-organisation of the Electricity Department in March, 1900, and it had attained considerable dimensions when, last year, the Corporation decided to whitewash its transgressions by obtaining Parliamentary authority for the same.

The clause originally drafted read as follows:—"The Corporation, if they think fit, may purchase, provide, sell, let for hire, *and fix, set up, alter, repair and remove and otherwise deal in lamps, electric lines, electric motors, fittings, apparatus and things for lighting*, warming, ventilating, the cooking of food, and for motive power, *and for all other purposes* for which electric energy can or may be used" . . . . &c. (The italics are ours.)

Naturally, the local wiring and fittings contractors resented this step, as they had resented the unlawful invasion of their territory by the Corporation; and the Electrical Contractors' Association of Sheffield lodged a strong protest with the Council. The result of this was that the Electric Lighting Committee offered to substitute a clause amended to read as follows:—"The Corporation may purchase and may supply, sell and let for hire, *but shall not manufacture*, electric motors, apparatus and things for cooking, heating and ventilating, and for motive power *and all other purposes for which electric energy can or may be used* . . . and may take . . . remuneration . . . for . . . such supply, sale, letting or use, *setting up, altering or repairing or removal*" . . . . &c.

The Association suggested that a proviso should be added restraining the Corporation from providing or fixing electric wiring or electric light fittings upon consumers' premises, but the Committee, acting on the advice of counsel, declined the proposal. The Association, therefore, resolved to fight the offending clause *in toto*, and it was not until the Bill was actually before the Committee of the House of Commons that the Council gave in and agreed to a compromise. The Clause as finally settled was published in our last issue, and is similar to the amended clause last quoted, with the exception that it applies specifically to electric motors, apparatus and things for *cooking, heating and ventilating and for motive power*, including the wiring and fixing, repair, &c., of such, but omitting the reference to "*all other purposes for which electric energy can or may be used*," which was so artfully allowed to remain in the amended clause formerly offered. The spoils of victory therefore remain with the Electrical Contractors' Association, which is to be congratulated upon its successful resistance to municipal aggression.

That this was absolutely a matter of commercial life and death may be gathered from the following facts, which, thanks to the Council's discreet surrender, were unfortunately not brought forward in evidence. The petitioners against the Bill represented firms which were assessed to the rates of Sheffield to the amount of over £2,000 per annum. In their petition they pointed out the gross injustice of municipal competition supported by the rates to which they contributed so heavily, especially when the Corporation officials were in a position to place obstacles in the way of passing and connecting-up installations put in by private contractors—a possibility of which they actually availed themselves. It was represented also that the Corporation did work at prices absolutely less than cost, and did not scruple to carry out work, not merely within the city, but beyond its boundaries! Had the matter been fought out, it would have been given in evidence that the Corporation had wired houses at £5 each, a price which, it was admitted, was 50 per cent. under the actual cost—there being 20 lights in each house. It was stated in excuse that the Corporation was anxious to assist "poor builders!!!" But what about the poor contractors? Even where a contractor consciously quoted below cost price, the Corporation underbid him, and the same contractor was cut out by the Sheffield Corporation in a town *14 miles from Sheffield*. The municipal canvassers have not scrupled to threaten intending consumers with delay in connection, if the Corporation should not receive their orders, and a canvasser, without seeing the tenders put in by contractors, has offered to do work for a less price than the lowest estimate submitted!

It is obvious that, under these conditions, two results must follow:—All private competition would be crushed, and the Corporation would establish an absolute monopoly. The wiring and fittings department of the Corporation must be carried on at a loss.

That these results are alike prejudicial to the welfare of the community needs no demonstration, and it is well that the danger has been averted. Our only regret is that the matter was hidden under a compromise, and that the scandalously unfair and dishonourable methods of the wiring department of the Sheffield Municipal Trading Association—alias the Borough Council—were not brought to light.

Colchester Tramways.—The T.C. has applied to the B. of T. for three months' extension of time in which to commence the electric tramways.

THE DEVELOPMENT OF THE CURRENT INTERRUPTER.

By J. WRIGHT.

(*Continued from Vol.* 52, *page* 1032.)

A more elaborate form of apparatus, working on a different principle, but involving fluid mercury in its constitution, is the mercury jet interrupter. Its general constructional principle is represented in fig. 8, where C, C, are a series of curved copper or steel plates, shaped as shown, and attached by screws to the periphery of a metal disc, supported by and capable of rotation around a central axis or shaft *a*. This arrangement constitutes one terminal of the

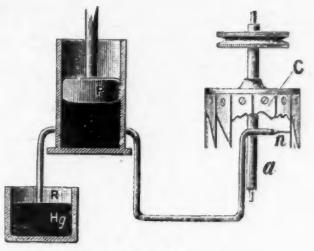


Fig. 8.

interrupter, the other being a mercury reservoir B, from which the mercury, Hg, is pumped, in the form of a jet, from a radial nozzle *n*. The commutator C, and the pump P, represented by a cylinder and piston in the figure for simplicity, are driven by a motor, and the interruptions in the circuit are secured by the jet of mercury alternately striking and missing the copper segments as they pass it successively. The whole is enclosed in a glass vessel which is almost entirely filled with paraffin to obviate sparking and to prevent the mercury from breaking up into globules.

A cursory study of the apparatus will enable the reader to understand that the frequency of interruption and respective time intervals of make and break, are readily controlled, the former by the speed of the motor, or by varying the number of segments by detaching a portion of them from the disc, and the latter by varying the vertical height of the nozzle, which, with the taper formation of the segments, C, permits of any adjustment from an absolutely uninterrupted circuit at its highest elevation, to a complete solution of continuity at its lowest.

Dr. R. H. Cunningham's modification of the mercury jet interrupter is, in general design, somewhat similar to the ordinary form of mercury jet apparatus already described, with a few important exceptions and additions. The revolving disc carrying the segments is in the shape of a shallow inverted cone, and is an insulator, being constructed of fibre, or other suitable material. The segments themselves are of sheet steel, V-shaped, and in total constitute an even number, the diametrically opposite pairs being of dis-similar polarity. They are thus alternately positive and negative, and are connected in sets to the two terminals of the apparatus. The mercury is contained in a shallow tray forming the base plate of the apparatus and provided with a number of radial fins which prevent the mass of mercury from rotating with the archimedean screw, which latter is attached to the driving shaft, and, enclosed by an encircling tube, serves to raise the mercury and discharge it through a hollow hub and two lateral lava-tipped orifices, against the inner surfaces of the steel segments. The circuit is thus completed through the two streams of mercury and the mass of that metal contained in the hollow hub, and is independent of any moving contacts beyond those created by the two mercury jets. An auxiliary attachment consists of two trumpet-shaped tubes attached to the revolving hub, and constituting an air-blast device, which, directed on a point just behind the mercury jets, renders the break extremely rapid. The whole is surrounded by a suitable container of glass, iron or fibre, and is driven by an electro-motor.

Some three years ago Prof. S. M. Kintner described a novel form of mercury jet interrupter, which differs materially from the forms already dealt with. The two electrodes consisted respectively of a Mariotte flask, made of iron, and having its base perforated by a circle of 10 equidistant openings, into each of which was fitted a nozzle, and a metallic plate, placed immediately below the flask. The latter contained about a pint of mercury, which flowed through the 10 nozzles on to the metal plate, thus completing the circuit. The interruptions were secured by a series of mica sectors, arranged concentrically with the line of nozzles, and attached to a vertical shaft, by means of which a rotary motion was communicated to them from an external source. The necessary adjustments for frequency, &c., were made by varying the speed of rotation, the number of mica sectors in action, and the number of jets discharging mercury, three possible variables, which permitted a large number of combinations to be made.

A mechanical mercury interrupter, on the principle of the water wheel, is the outcome of the inventive genius of N. G. Van Huffel. A miniature paddle wheel, rotated by a stream of water, drives a shaft to which is attached a spider, carrying four platinum pins which dip successively into a bath of mercury. A metal disc, mounted on the same shaft, dips into a second mercury bath, and thus completes the circuit through bath No. 1, the pins, disc and bath No. 2. An especial advantage claimed for this device is that the water, besides providing the necessary power to drive the interrupter, subsequently flows away over the surface of the mercury in the bath, carrying with it all impurities such as may arise from oxidation, &c.

The Hirschmann interrupter, devised by W. A. Hirschmann, although involving metallic mercury in its construction, is not, strictly speaking, a mercury interrupter, in that the latter only performs the secondary office of amalgamating the actual contacts. Fig. 9 is a diagram of the device, which consists of a vertical shaft S, rotated by

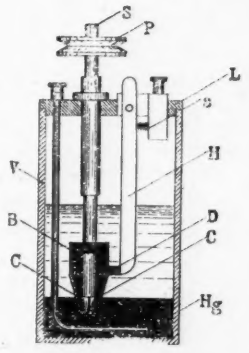


Fig. 9.

power communicated to a grooved pulley P, and supported in a bearing carried by the lid L of the containing vessel V. To the lower extremity of the shaft S is fixed a hollow cylindrical ebonite box B, carrying two copper segments, C, C, each of which is provided with an outlet from the interior of B. The base of the latter is tapered slightly, and also provided with an opening or inlet, set at such an angle that it scoops up the mercury Hg into the interior of B as the shaft revolves. The mercury emerges from B by way of the outlets in the copper segments, and, spread by the fixed contact D, serves to thoroughly amalgamate their surfaces, and assist in maintaining a good contact between them and D, which latter forms the remaining terminal, and is supported at the extremity of a vertical lever H, connected with a second terminal on the lid, the necessary contact pressure between D and C, C, being maintained by the thrust of the spiral spring *s*. The apparatus is said to work noiselessly and well.

An extremely simple form of mercury interrupter, suggested by Sprague, is based upon the well-known principle of the Lippmann electrometer. The negative terminal consists of mercury contained in a suitable vessel or cup, its surface being covered with a thin layer of acidulated water. A platinum wire, supported in such a position that its lower extremity just touches the metallic surface of the mercury, acts as the positive terminal. On the passage of a current, a film of gas is formed around the platinum point, causing

the mercury to momentarily break contact with it. The gas then makes its escape, and the circuit is again established as before. This is the fundamental principle of the electrolytic interrupters to be described presently.

Roiti's mercury interrupter consists of a suspended metallic spiral, the lower end of which just dips into mercury. It is provided with an iron core, and carries the current to be interrupted. The core is in turn supported by a stem which carries a toothed wheel, meshing with the turns of the spiral, and so devised that by turning the supporting stem, or moving it on a vertical axis, the number of turns in the spiral, left free to move, can be regulated at will. The principle underlying its action is practically the same as that involved in Roget's original interrupter, the only difference being in the means of adjustment provided by the core, stem, and toothed wheel, by means of which the frequency of interruption can be varied as desired. The whole apparatus is enclosed in a tube containing petroleum, which serves to damp the motion of the spring.

A so-called "string" interrupter, suggested by L. Arons, consists of a copper wire A B, fig. 10, stretched between the two terminals A and B, which are electrically connected with

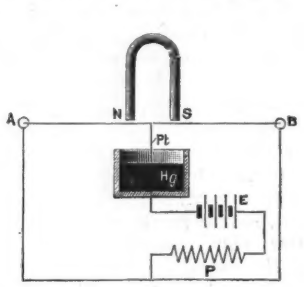


Fig. 10.

one another and with one terminal of the primary circuit. To the centre of this wire is attached a thin platinum branch wire Pt, the lower extremity of which just dips below the surface of the mercury Hg, contained in a suitable vessel, and surmounted by a layer of water to prevent oxidation. P is the primary winding of the induction coil, and E, the source of current; a brief study of the connections will show that the current divides at Pt, and flows in opposite directions to A and B respectively, where it re-unites by way of the main connections, and flows back to E through the primary winding P. The wire is set in vibration by the attraction of a horse-shoe permanent magnet N S arranged above it, with it poles N and S in close proximity to the wire.* Normally, the platinum branch Pt makes contact with the mercury Hg, and a current is established in the coil, but at the same time, owing to the flow of current towards A and B, the wire is attracted by the magnet, lifting Pt out of the mercury and breaking the circuit; the original condition is then again restored, and the cycle of operations repeated. Arons states that a frequency of interruption as high as 800 to 1,000 per second is readily attainable with this device.

(To be continued.)

[Note.—I am indebted to Mr. G. Bowron for pointing out an error in my description of his interrupter, illustrated in fig. 3. The spring S is not, as stated in the letterpress, attached to the movable armature A, but is separate and distinct from it, both ends being free. Its especial office is to cushion the back stroke of the hammer, yielding the energy thus stored, to the ensuing forward stroke. The distinctive feature of all Mr. Bowron's breaks lies in the fact that the hammer, during its working stroke, is *free* and uncontrolled; a more rapid break is thus obtained, and the platinum points do not get hot, or even warm. I understand that Mr. Bowron is shortly putting a still further improved type of interrupter on the market, the advent of which will be awaited with interest by all coil users.—J. Wright.]

* Obviously the wire A B should lie in a horizontal magnetic field.—Eds. Elec. Rev.

STREET LIGHTING TESTS.

The following recent measurements, which have been made by Mr. Hoadley, borough electrical engineer of Maidstone, are of great interest, showing as they do the comparative results obtained with an arc lamp, with Nernst lamps (supplied by the Electrical Co., Ltd., of Charing Cross Road, W.C.), and an incandescent gas lamp under actual conditions. The readings were taken with the Trotter illumination photometer in the streets, and are in terms of candle-feet:—

Distance.	Arc lamp reading.	·5 Nernst with prism globe.	·5 Nernst with clear globe.	·25 Nernst with clear globe.	·25 Nernst with clear globe.	Incandt. gas lamp.
10 ft.	—	·052	·125	·095	·12	·065
15 „	·29	·05	·105	·04	·06	·04
20 „	·275	·034	·052	·028	·04	·026
30 „	·135	·02	·025	·018	·019	·012
40 „	·055	·0085	·013	·006	·008	·0055
50 „	·043	—	—	—	·0055	—
60 „	·025	—	—	—	—	—

It will be seen from these tests that whilst the arc lamp continues to hold its own, the Nernst, allowing for its lower consumption of power, makes a very good second. The figures given for the gas lamp are, of course, significant only in that they show the distribution of the light as compared with that of the Nernst and arc lamps, as the gas consumed per hour, the age of the mantle, &c., are not given.

Life tests on the Nernst lamps have also been made by Mr. Hoadley, with the following results:—

Second Life Test of ½-ampere Nernst Lamps.

6 lamps	210 volts	with 20-volt resistance	= 230 volts.
6 „	215 „	„ 20 „	„ = 235 „
6 „	220 „	„ 20 „	„ = 240 „

Switched on 12 noon, April 8th, 1903. Switched off 3 p.m., June 22nd, 1903.

230-volt lamps.	235-volt lamps.	240-volt lamps.
1. 555¾ hrs.	1. 1,675½ hrs.	1. 1,802* hrs.
2. 1,494 „	2. 598 „	2. 707 „
3. 1,802* „	3. 1,802* „	3. 824½ „
4. 1,802* „	4. 1,802* „	4. 1,802* „
5. 1,802* „	5. 1,802* „	5. 476* „
6. 1,802* „	6. 1,802* „	6. 411* „
Average hours burning = 1,543 hrs.;	1,580 hrs.;	1,004 hrs.

* The lamps still burning have been taken as burnt out at 1,802 hours.

These tests are highly noteworthy, and represent a great advance over previous results. A large number of Nernst lamps are used at Maidstone for public lighting, and they are being tried in many other towns. We look forward to the announcement of the results obtained in the latter with much interest.

LEGAL.

Patent Exploitation, Ltd., v. The American Electrical Novelty and Manufacturing Co., Ltd.

(Continued from page 5.)

On Thursday, June 11th, Mr. James Swinburne having been re-examined by Mr. Walter,

Prof. John Cormack was called. Replying to questions by Mr. Moulton, Witness said he used to be the Lecturer in Electrical Engineering in Glasgow University and in the Yorkshire College, Leeds. He was now Professor of Mechanical Engineering at University College, London. Speaking as an electrician, he saw nothing electrically novel in plaintiffs' specification. There was nothing novel in the physical states of the layers. It was quite common at that date to have the inner and the outer layers of batteries in a pasty state.—Speaking generally as an electrician, do you see anything in the receipt or the description of the special battery to instruct the public as to what electrodes or exciting substances are to be used, provided the result is two plastic layers?—No; they do not mention any variants whatever. It is a very wide claim. They may alter the form of the cell, they may alter the excitating agents, they may alter the depolarising agents, they may use acid excitants as well as saline.

This is quite a common form of Leclanché, looked at electrically?—Yes, the ordinary Leclanché.

You agree with what Mr. Swinburne said about hygroscopics being of no use in a closed cell?—Yes; no use whatever, unless the sealing happens to be broken; possibly they may be of service then.

This is described as being sealed with bitumen. Do these cells get broken frequently?—If they are subjected to rough usage they might possibly, but, under ordinary circumstances, they are put in a place and left there, and not tampered with.

It has been suggested that Leclanché always used his dioxide of manganese and his carbon in coarse lumps?—I do not think that that was the case. Answering further questions, witness said he had tried experiments upon the manufacture of dry batteries with powdered manganese and powdered carbon for the central layer.

He had varied the amount of pressure applied, and had also varied the amount of pulverisation.

Excepting as a matter of degree, is there any difference between the effects of more or less ramming and more or less pulverisation?—The effect of ramming is very much more considerable than the effect of pulverisation.

You have seen the defendants' cell made?—Yes; I have made many myself.

Mr. Astbury: Is this gentleman in defendants' works?

Mr. Walter: He has been through and spent a large amount of his time there.

Mr. Moulton: Just describe it?—The piece of paper is placed in the bottom of the zinc pot; a roll of blotting paper is then inserted into the zinc pot and arranged so that it comes into contact with as many points as possible. Then a carbon rod is taken, and some of the depolarising mixture placed round the rod, and the rammer is placed over the rod and hammered down with a mallet as hard as it can possibly be hammered.

Have you made tests of a large number of cells on different degrees of ramming?—Yes; I tried four degrees of ramming, and tested about six cells for each degree, and the results were very uniform. What is rammed, is in the shape of a damp powder with about 5 per cent. of water. The harder the ramming the better.

Does it make difference whether the mixture of sal-ammoniac and chloride of zinc is put into one layer or the other, or poured in afterwards?—No; I do not think it makes much difference, provided there is not too much there.

Does it make any difference electrically whether it gets from the blotting paper into the central layer, or whether it is put into the central layer after it has been all made?—No, so long as the quantity is the same in all cases.

If you take a defendants' cell as sold and open it, does the blotting paper still retain its shape of sheets?—Oh yes; in fact, after it has been moistened and drained, it is almost the same figure.

Speaking as an electrician, do you see any reason why a Brandon should not work just as well as one of the dry cells according to the E.C.C.?—I find they work quite as well. That, of course, was to be expected from the construction of them.

Did you find the E.C.C. cell on the market and test it as against the Brandon?—Yes; with two electric bells. I put two batteries on the two bells and changed them from time to time, so as to eliminate any small difference there might be in the bells.

What do you say with regard to the electrical behaviour of the two batteries?—The Brandon showed up rather better.

And speaking as an electrician, is that what you would expect—that the Brandon would be at least as good as the other?—Yes, at least as good. It depends to a great extent on the amount of moisture in the two cells.

Is there anything in the plaintiffs' specification which secures exceptional electrical behaviour as contrasted with other forms of Leclanché cells?—No; I think there is no outstanding feature of merit.

With the exception of the special receipt that is given, is there anything in the plaintiffs' specification to guide you whether your paste is to be a special permeable paste, or how you are to get a special permeable paste?—No, there is nothing to guide me. I think I prefer to form it myself of somewhat different preparations; there is too much flour in it, I think, to give the best results.

Have you made a Skrivanoff of 1892?—Yes. Following the directions I got a paste. I mixed a powder with chloride of zinc and sal-ammoniac—chloride of sodium, rather—and pasted it on the carbon block.

Did you get a useful battery?—Yes; it did very much better than I anticipated.

Is that a battery which there is any difficulty in making in a circular shape?—It is a little trouble to make the chloride ammonium, or the stuff that is so called; it takes three hours to make. There is no other difficulty. It is unskilled labour, really.

Did you do it by following the directions given in the specification?—Yes, the exact instructions; I used the red oxide of mercury.

Have you made Skrivanow, 15,063, of 1887?—Yes.

Does that give a workable cell?—Yes, it works.

Is there any electrical objection to it?—It is not as good as some of the others electrically, but it is a practical battery.

Did you make a Germain?—No, it was a well-known cell, and I thought there was no need to make it. It would work quite well.

With the exception of the shape there described, and the question of the ramming, do you see any distinction between that and the defendants' cell?—There is no practical distinction, the form is the only difference.

Did you make a Thiebaut?—Yes, with a clay outer-layer and peroxide of lead inner-layer.

Is peroxide of lead a known depolariser?—Yes, and very largely used. It is a powder.

Did that work?—It worked very well.

Answering further questions, Witness said he made an inner-layer like that in Jensen, No. 4,369 of 1885. He made it with a carbon electrode and powdered manganese dioxide and carbon. He strapped the mixture on to the carbon pole by a sheet of canvas.

When you have got that central electrode, that is to say, the carbon with the rammed mixture of the two powders, would an electrician know, that that could be put either in a fluid or a paste external layer?—Yes, it would depend on whether he wanted to get a dry battery or a wet battery.

Was that the common knowledge of the time?—Yes, it was the inner element of the Leclanché battery. One way of forming the inner element of the Leclanché.

Supposing you were to put that into a fluid rendered pasty by sawdust, or supposing you wrapped it round with blotting paper, do you see any difference between that and the defendants' cell?—No, none whatever if you use the outer layer composed of blotting paper. Further questioned, Witness stated that he had not made the Gassner cell, but he had used them. They were extensively used, and had considerably improved lately.

Is the defendants' cell a good one?—Yes, I do not know a better.

It has been suggested that the plaintiffs' cell would be—I was going to say everlasting—that it possessed a longevity beyond a wet or dry Leclanché?—I do not think that they last so long as the wet Leclanché.

Now take the dry Leclanché?—Well, certainly at first they did not last as long as the Hellesen, because I tried them and adopted the Hellesen in preference to them, but I cannot say anything about the lasting properties of the improved cell of the E.C.C. which is on the market.

Taking a cell made according to the plaintiffs' prescription, has that any superior lasting qualities—I will put it first of all—a wet Leclanché?—It is not so good as the cell that is on the market—the one that is made from the specification.

It is not so good?—No, and, therefore, it is not probably as good as many wet Leclanchés for lasting properties.

Have you found that these E.C.C. cells are not so good as the wet Leclanché in lasting properties?—I did not quite mean that exactly. I mean that they will get dry sooner than the wet Leclanché. They cease working sooner than the wet Leclanché.

Have you tested the prescription, and is it as good as the E.C.C. cell?—No, the present E.C.C. cell is better than the cells made according to the prescription.

When you made it according to the prescription, what did you find was the consistency of the inner layer?—I made a number of cells with manganese and carbon of different degrees of pulverisation. It is a thick mud with some liquid on the top.

In the cells that are now in the market that are successful—take the defendants', as you say it is the best—is the material that is used for the inner layer anything other than a slightly damp powder?—The inner layer contains about 5 per cent. of moisture as prepared and rammed.

Have you tested the plaintiffs' cells through resistance—I mean the E.C.C. cells?—Yes, I put them on resistances.

Is there an any difference between their behavour and that of a Brandon?—I have tested Brandon's cells against them; the Brandon's are practically the same, if you have a zinc pot and a porous pot of the ordinary type and fill up the intervening space. I have tested both on resistance and bells.

Is there any foundation for suggesting that the plaintiffs' batteries do not polarise and that Leclanché's do?—All Leclanché batteries polarise, dry or wet.

Including the plaintiffs' and the E.C.C.?—Yes, they polarise more, the greater the current taken from them.

It has been suggested that in those made according to specification the depolariser kept pace with the polarising and it did not in others. Is there any foundation for that?—No, they are all the same practically—they have all the same electrical action. The polarisation goes on the same.

And is there anything in the fact that the pastes are in two layers, which would secure any particular rate of polarisation or non-polarisation?—No. Of course it stands to reason that the greater the number of contacts between the manganese dioxide and the carbon the less the polarisation will be.

And was that well known?—Quite well.

Look at Jensen. Is the external layer and electrode there described as good on the point of polarisation as any that exists to-day?—Yes, it depends on the extent to which it was compressed; but the harder it was compressed the better results it gave.

Assuming that the ramming and compressing was the same as what is done to-day, has there been any advance at all on what Jensen describes?—The Jensen electrode is, I think, practically the same as the electrodes of the best cells of the present day.

Were the agglomerates in the Leclanché porous?—I should think they were porous. I have never tried their porosity. They would be very little used if they were not porous—only the surface would be of any effect.

They were largely used?—Yes, and are very largely used still.

Cross-examined by Mr. Astbury, Witness said that in 1893 or 1894, he made a series of experiments, and selected the Hellesen as being a battery of greater efficiency than the E.C.C., but he did not know that that would be the same now, as the E.C.C. pattern had improved. There was no difference, as far as polarisation and light was concerned, but the Hellesen seemed to last better than the E.C.C. over a period of time; they kept their materials, probably, in a wetter condition. He had studied electricity since 1881, and he had a distinct recollection of the Hellesen, the E.C.C., and the Gassner before 1893. To some extent he had studied the literature of dry batteries, from time to time, prior to coming into this action. He began lecturing on dry batteries in 1892.

Can you mention any text-books that you have got the common knowledge from?—I read almost all the text-books which were considered good.

Is there any difference, electrically, between a wet battery and a dry battery?—No.

Will you mention a single battery that had layers in, like the plaintiffs', in their physical state, before 1890?—There are Thiebaut, Skrivanow, Skrivanoff, Hellesen, and quite a number of them.

Is your answer substantially to the effect that because of what we see in these earlier documents there is nothing novel in these two layers?—Not completely.

Are you prepared to say that you did see a Hellesen battery in existence before 1890?—I am not prepared to say I did not.

I suggest to you it did not come out as a battery until 1891?—That may be so.

Do you agree with Mr. Swinburne that for the commercial success of a battery a number of very small matters may be of great importance?—Yes. It is almost entirely in the details that the success lies—method and manufacture.

And you may have the batteries both electrically the same and commercially vastly different?—Yes.

Do you seriously suggest a Lelanché, with powdered manganese and carbon, was ever put on the market other than in the agglomerate form?—I think so.

Did you ever see one?—No; I never opened one that contained it.

Give me any authority for saying that a Leclanché battery, with manganese in powder and carbon in powder, was ever put upon the market?—I have none; no definite proof of it.

I put it to you, that if you make a battery strictly in accordance with the plaintiffs' proportions, and take an E.C.C. battery, which is tightly rammed in—as my friend calls it—the difference in efficiency, on a resistance of 5 ohms is absolutely unappreciable. Have you tried the experiment?—No; I have not tried it on exactly similar cells, but I have made the plaintiffs' cells with 4½ in. × 2 in. zinc, and I have tested them, and I have tested E.C.C. cells with 5 in. × 2 in. zinc.

Do you agree, provided you keep a damp path, it is better to pack the manganese and carbon tightly?—My experiments show that ramming improves it.

Do you think, with Mr. Swinburne, that it was perfectly common knowledge among electricians that in order to get good contact and good conductivity you must pack the things fairly tight and exclude all air spaces?—Yes, as tight as you can.

If you make the plaintiffs' battery and take these two powders with sufficient water to form a semi-solid and pack it in tight enough to exclude all air spaces, is that not an efficient battery?—Yes, it is a very good battery.

And when you say that ramming is better than pulverisation, do you mean anything more than that if you pulverise and do not press it in tightly you do not get as good results as if you do pulverise and do press it in tightly?—No, I do not think that that implies everything.

You made a cell according to the plaintiffs' specifications. Have you tested that on a 5-ohm resistance?—Yes, with quantities according to the specification.

In carrying out the plaintiffs' directions, certain things are obvious to you, for instance, the tightly packing gave better conductivity?—I knew that, but it is not obvious from the specification.

Do you know as an electrician that you get better conductivity if you pack tightly?—It never occurred to me to ram that battery.

Aye or no—as an electrician?—Yes.

Do you also know, and is it obvious to you that you must exclude the air space to get a good result?—Yes, and put in as much depolariser as possible.

It is put to you that 2½ ohms is an utterly unfair resistance to take in order to get a fair test of the ordinary work that these batteries have to do?—Not in my opinion.

I am instructed by a gentleman that it is perfectly wrong that you can have any ordinary practical bell-ringing with anything like a resistance of 2½ ohms outside the cell?—That is not true at all.

Then you utterly differ from Mr. Swinburne?—Yes. You can have bell circuits with less resistance than 2½ ohms.

Do you agree with Mr. Swinburne that for the purpose of preventing powdered manganese from getting to the zinc and for the purpose of allowing the free permeation of water, the blotting paper in the defendants' battery performs precisely the same function as the plaster of paris and flour in the plaintiffs'?—Yes, and probably it is the better way, too.

How long did this exhibit which you call the Brandon ring a bell?—I got two bells, and put one on the Brandon and one on the E.C.C., and interchanged them so as to eliminate any difference. They both rang 65 and 70 hours. The E.C.C. stopped three times to do that, and the other did not stop at all.

Can you explain how it is that the E.C.C. battery has proved so enormously efficient on the market if your test was a fair one?—This was a good cell; it was on the market at a cheap rate.

Taking this cell of yours and the Brandon, what would be the difference in the cost?—The Brandon would be the more expensive.

Did you ever know a Leclanché battery made, closed up according to Brandon's document with sawdust inside, and sold on the market?—I never came across one.

Do you suggest that anybody trying to carry out the directions of Skrivanoff or Skrivanow would make the plaintiffs' battery?—Probably not the plaintiffs' but the defendants'. I think they might arrive at that form.

You think that if you put Skrivanoff or Skrivanow into the hands of a competent workman and told him to carry it out he would make the defendants' battery?—A competent electrical engineer would.

I said in the hands of a competent workman?—Not in external appearance.

If you read Germain and look at the defendants' battery you can see no difference except between the shape and the ramming. Is that true?—Yes.

Do you agree with Mr. Swinburne that Thiebaut's papers contain a lot of rubbish?—Yes.

Is Jensen's specification a wet cell, and a wet cell only; and is it obviously so from the document?—No.

Point out a single word where there is any suggestion of making a dry cell?—I do not think there is one, but it does not say it is to be wet.

Is it a fact that the plaintiffs' battery is an extremely good depolariser?—Yes, it is a good cell.

You have told Mr. Moulton that the pole in Jensen was as good a depolariser as the carbon pole with the plaintiffs' mixture put round it?—Yes, quite as good. Anyone knows that; it is matter of common knowledge.

I am told by one who knows that it is exactly the contrary. Do you know that the Gassner cell had this agglomerate pole with an excitant mixture between that and the zinc?—Excuse me, Jensen was not an agglomerate.

Do you know that Gassner fell out of use because it was a very inefficient cell compared with these others?—I do not think it is out of use yet.

Tell me any document which points out how to make a battery as efficient as the plaintiffs' with the agglomerate pole?—Leclanché's agglomerate pole, I think, would give you quite as good results.

Have you ever tested the Leclanché battery made according to the directions in the *Comptes Rendus*?—No.

Have you ever heard of a dry battery so made?—No, except that all dry batteries are more or less made in the same way. If they are rammed they are rammed in position or inside the inner layer—it makes no difference whether they are rammed and put inside or rammed inside.

Have you ever heard of a battery being made before 1890 with an agglomerate pole, that worked as well as the plaintiffs'?—No, I think not.

Have you made a test of any sort or description to find whether or not the battery with the agglomerate pole will give the same efficiency as the plaintiffs' battery?—No, but I am sure of it.

You have described a pole of carbon surrounded by compressed carbon and manganese. Did you ever know a dry battery having a pole so surrounded made before 1890?—I am not certain that it was made, but it was known before 1890, and Jensen and Hellesen's specification is dated 1885. Gassner was of that type, without the carbon pole, and it was agglomerated by baking; it was harder, but otherwise the same.

Is the result of your evidence this—that you know of no battery on the market before 1890 that had a pole of carbon surrounded by compressed manganese and carbon?—I never bought a cell of that type. It may have been on the market, but I never heard of it.

Mr. Fletcher Moulton said he did not want to re-examine the witness.

The further hearing was adjourned.

(To be continued.)

The Marylebone Electric Supply.

In the Chancery Division of the High Court of Justice on Thursday, July 2nd, Mr. Justice Buckley decided an action brought by the Metropolitan Electric Supply Co., Ltd., against the Mayor, Aldermen and Councillors of Marylebone. The action was to enforce specific performance of a contract for the sale of a portion of the plaintiffs' undertaking to the defendants. Mr. Cripps, K.C., Mr. Astbury, K.C., and Mr. Sargeant appeared for the plaintiffs; and Mr. Moulton, K.C., Mr. Buckmaster, K.C., Mr. Clayton and Mr. Cave for the defendants. The facts are clearly set out in the following judgment:—

His Lordship said this is an action for specific performance, and the facts are these: Plaintiffs, the Metropolitan Electric Supply Co., Ltd., before 1901, established in Marylebone and, as I understand, elsewhere, an electric supply undertaking. In July, 1901, an Act was passed which by Sec. 2 provided that the plaintiff company should sell and the Borough of Marylebone should purchase the Marylebone undertaking and business of the company. The undertaking and business there referred to was subsequently defined as being "that part of the undertaking and business of the company which is at the date of the purchase in the area of supply under the Metropolitan Electric Supply (West London) Lighting Order, 1899, including all lands, property, plant and effects of the company in the said area." It is common ground between the parties that there exists a contract for purchase. That Act having been passed providing that notice to treat was to be given within six months after the passing of the Act, the period was extended and a notice to treat was given on November 1st, 1901. The parties did not agree as to the price which was to be paid, and under some words in the Act there was a reference to arbitration in which two arbitrators and Mr. C. A. Russell as umpire, heard the case for many days, with the result that, on February 4th, 1903, the arbitrators having differed, the Umpire made his award, and he awarded £1,212,000 as the purchase price and compensation. On February 10th, 1903, that is, six days after the award, this action was brought by the company against the Borough of Marylebone for specific performance, and it was brought for the reason that two questions had arisen between the parties, which I will deal with shortly. The more important question was this: After the notice to treat was given, on November 1st, 1901, the company went on, as it seems to me they were bound to do, with the control of the undertaking and meeting capital expenditure. As to what it was for, I have not heard evidence, but I understand it was made in respect of various matters such as these. The company, under the orders or Acts by which they are bound, are compelled to give a supply to consumers who are requiring electricity. In order to do that, they have to make connections and boxes in the streets, and do other works. Further, I understand that, for the purposes of the undertaking, they erected some generating stations, and did other works which made a large capital expenditure. As appears by a recital in the writ, this matter was ventilated before the arbitrators. The writ contains this recital:—

"Whereas from December 31st, 1901, the company have been, and still are, in the position of carrying on the Marylebone undertaking and business, and allege that since December 31st, 1901, they have made and incurred a large capital expenditure, I was of opinion that the matters referred to me did not include the adjust-

ment of the rates of the Borough Council in respect of such capital and expenditure, and accordingly, in assessing the purchase money and compensation to be paid by the Borough Council to the company for the Marylebone undertaking and business of the company, I have not allowed anything for the company in respect of such capital and expenditure."

In this action it is alleged by the plaintiffs, and is not denied by the defendants, that there has been capital expenditure of the kind described. The question I have to investigate is whether any, or what part, of the capital expenditure to be borne as between vendor and purchaser is a matter which, by the Act of Parliament, was referred to the arbitrators, and is outside my jurisdiction, or is a matter which the Act has left to be dealt with in the ordinary course in which this Court would deal with the adjustment of such matters as between vendor and purchaser. The second section of the Act of Parliament says:—

"The sale shall be made for such purchase money and compensation being the same in gross, and on such terms and conditions as may be agreed upon between the company and the Council, or failing agreement shall be determined by arbitration."

Does that refer it to the arbitrator to determine the whole matter as to how expenditure made subsequent to the date of the contract is to be borne, or does it leave that open to be dealt with by this Court? I cannot help saying this, that in any arbitration of this kind, it is not possible for the arbitrators and umpire when they come to make their award to direct what must be done down to the date of the completion. After the date of the award and down to the date when the money is paid, and the transaction has been made, there must remain matters subject to adjustment, and these must be adjusted by the Court. It is impossible, therefore, that those words, "On such terms and conditions as may be determined by the arbitrator," should be words which should exclude the jurisdiction of the Court as to that subsequent period. Neither do I think that they exclude the jurisdiction of the Court in that earlier period. It seems to me I have to deal with this as between vendor and purchaser. How does the matter stand? The thing sold is the undertaking of the company in Marylebone. It is a thing which necessarily fluctuates. It may consist to-day of so many miles of cable lines and connections, and to-morrow or next week, of so many more. It is a thing which will be continually growing or decreasing. The thing which has to be paid for, is that thing at the date of purchase. Then you are to buy an undertaking at the date when the contract is made subject necessarily as it seems to me to the fluctuations in that thing which may arise in the proper conduct of the business before you come to completion. It was the duty of the vendors when the contract was made to see that they fulfilled the obligations under the Act which ordered the continuance of supplies to customers, the laying down of sufficient connections to houses where required, and the alteration in the undertaking as it was to the date when you come to completion, is that which purchasers are entitled to require vendors to offer. On what terms? On fair terms in a Court of Equity as between vendor and purchaser. A purchaser is not to have gratuitously an undertaking as extended or altered, neither is a purchaser to have thrust upon him an undertaking extravagantly or unnecessarily enlarged. It is a question of adjustment between the parties. Therefore in giving judgment for specific performance it will be necessary for me to direct an account as between vendor and purchaser. An account ought to be taken between these parties to see not how the purchase price which the manufacturers determined is to be enlarged, but what sum in addition to the purchase price or in diminution of it ought to be debited or allowed as between vendor and purchaser in completion of the contract. The other question between the parties is this. The undertaking in the largest sense consists of the lines which are laid and the capital which is sunk in doing all that work, and there are also certain leaseholds. It is suggested in the pleadings that there are freeholds also. The defendants suggest as the value of these, £46,000 of this £1,212,000 which the Umpire has awarded. It is suggested as regards some of these leaseholds that the company is not in a position to show good title. As regards title, it seems plain to me here that that which is sold and bought is simply such title as the company has under the Act. Whether it has a good title, or bad title, or no title at all to any of these leaseholds or freeholds, the contract stands just the same. It is possible if the award was made on the footing that there was good title to all these freeholds, that it is subject to alteration. I am going to direct an inquiry as to title as regards leaseholds and freeholds, not with the view or intent that it will affect in the smallest degree the contract between the parties, but simply for the reason that if good title is not shown to some of those it may be that compensation ought to be allowed. What is the material thing in this case? There was an Act passed in July, 1901; there was a notice to treat on November 1st, 1901; there was an award made under that notice to treat on October 4th, 1903. I think the defendants are perfectly justified in what they say in paragraph 2 of their defence, that the award constituted a contract on the part of the defendants to purchase from completion the Marylebone undertaking and business as defined by the Act at a price of £1,212,000, subject to ordinary rules and conditions as between vendors and purchasers. The result, as it seems to me, therefore is that on February 4th, 1903, there was a concluded contract to purchase for that sum, and all I have to do consequently is to adjust rates between vendors and parties at that price. This purchase sum is very large. The borough will raise money in the usual way—by borrowing—and it is stated that they have applied for the necessary leave to enable them to borrow it, and that at present it has been refused. There is an appeal pending to the Local Government Board from that refusal, and I am going to fix a date when this purchase might reasonably be completed. I don't intend the defendants to be placed at any disadvantage. In fixing the date I do fix, if I give liberty to apply it seems to me I shall be protecting the defendants. I give judgment for specific performance constituted by the Act and the award under the Act. I direct an inquiry as to title of leaseholds and freeholds, if any, mentioned in the list which was handed to the arbitrator, and which must be identified for the purposes of this order. I then refer it to Mr. C. A. Russell, who is the umpire, and who is familiar with all this matter, to take, for the purposes of the completion between parties accounts of the capital and other expenditure, and of the receipts of the plaintiff company from December 31st, 1901, to the completion of the purchase, and I refer it to him to determine what part of such capital and other expenditure ought for the purpose of such accounts to be allowed as between the plaintiffs and defendants. I refer it also to Mr. Russell in case good title is not shown to any of the freeholds or leaseholds to say what sum, if any, ought to be allowed as compensation. I fix December 31st, 1903, as the date of completion. I direct—and the plaintiffs have consented to this—that of the purchase money, £100,000 be paid into Court to be dealt with as the Court shall direct. I intend that sum to be available to answer the compensation, if any, which the defendants may be allowed, if there is still defective title as to the leaseholds, and to provide for the possibility that the result of the accounts which I have directed might be to show something due to the defendants, and not to the plaintiffs, and to make them absolutely sure that they cannot part with the balance of the purchase money, and take conveyance without being safe. I also give liberty to apply to extend the date fixed for the completion.

A discussion afterwards took place as to the power his Lordship had to appoint Mr. C. A. Russell as arbitrator. It was ultimately decided that if parties should not come to an agreement as to Mr. Russell, then reference would be to Mr. Pollock.

Mr. Moulton said there were very substantial questions to be settled, and in his opinion they would certainly form matter of negotiation between the parties.

His Lordship: I sincerely hope so.

The question of costs was reserved.

PARLIAMENTARY.

Warmley Electric Lighting.

A Select Committee of the House of Commons, presided over by Sir R. Gunter, on 2nd inst. considered the confirmation of the Board of Trade order to the Warmley Urban District Council, which was contained in the Electric Lighting Confirmation Order Bill, No. 5. Mr. H. O. Gregory appeared for the Urban District Council, and Mr. Balfour Browne, K.C., opposed on behalf of the Bristol Gas Co.

Mr. Gregory, in opening the case, gave particulars of the population, area, &c., of Warmley, but at present no provision had been made with regard to public lighting in part of the district. The Bristol Gas Co. had power to supply the district with gas, but they were not bound to do so, and the District Council had come to the conclusion that the best course was to go in for a system of public lighting by means of electricity. They, therefore, applied to the Board of Trade, who had granted a provisional order, subject to the question of the insertion of what was known as the Bermondsey clause, and which was practically the same clause that the Committee had been asked to insert in the case of the Walton-on-Thames order. He contended that in this case there was no special reason for the insertion of such a clause, for the only *locus* of the petitioners was that they were ratepayers to the extent of a rateable value of £74 a year only, and the promoters did not intend to enter into competition with the petitioners. It was true that when the promoters first applied to the Board of Trade, they were approached by the petitioners, and then assented to the insertion of the Bermondsey clause, but the Board of Trade pointed out the danger, and then they refused to consent.

Sir S. Williams, clerk to the District Council, gave evidence in support of the Bill, and said they hoped to get a supply of electricity from the Somerset Electric Power Co. If they could not get current from that source, they could get it from the Bristol Corporation or the Bristol Tramways Co.

Mr. Balfour Browne, K.C., addressed the Committee for the petitioners, and said that they had no objection to the petitioners supplying electricity, but they objected to improper municipal trading. But for the uncalled-for interference of a Government Department the order would not have been before the Committee, and he protested against the Board of Trade trying to overrule the decision of Parliament. There was no harm in allowing a local authority to supply electricity so long as it did so on commercial principles. If it could make the undertaking pay, it was quite obvious that there was a public demand for it; but if, on the other hand, it could not make it pay, that was an indication in itself that it should not have possessed the power at all. He instanced the case of Salford, where the local authority was making a loss of £7,000 a year on its electrical undertaking. Only 400 people were using it, and 36,000 people had to pay for the light to these people. The petitioners had 5¾ miles of mains laid in the district, and had therefore not failed in their duty to the locality.

A member of the Committee pointed out that in this case any share of loss which would fall upon the gas company would be very slight, seeing they were only assessed at £74.

Mr. Balfour Browne mentioned that the principle was the same, and Parliament had recognised it in the case of the Dundee tramways.

The Committee decided that the preamble was proved, subject to

the insertion of the following clause:—"The undertakers shall once in every year after the third year's working of the undertaking cause to be laid before them a statement and balance-sheet of accounts of the undertaking drawn up in accordance with the form of accounts prescribed by the Board of Trade for a local authority under the Electric Lighting Acts of 1882 and 1888; and the undertakers shall thereupon fix annually the charges to be made for the supply of energy in the then ensuing year at such rates (not exceeding the maximum rates specified in the order) so that as far as it is reasonably practicable the revenue for that year shall not be less than the expenditure for the year."

Joint Committee on Municipal Trading.

Lord Crewe presided over a sitting of the Joint Committee on Municipal Trading on 2nd inst.

Mr. R. Barrow, controller and auditor of the accounts of Liverpool, and treasurer and vice-president of the Incorporated Institute of Municipal Treasurers and Accountants, described the system adopted in Liverpool for dealing with estimates, and also the system of book-keeping adopted. He was strongly in favour of keeping municipal accounts on income and expenditure lines. In reference to trading accounts particularly, he was satisfied that any other lines than that of income and expenditure would be improper. The accounts for the Liverpool tramway and electric supply undertakings were framed on these lines, and he believed they were the lines adopted by nearly all the other municipal trading bodies. Their tramways in Liverpool were purchased from a company in 1897, and the Corporation proceeded to electrically equip them, and the result of last year's working was that after providing for sinking fund and all charges that could possibly be made on revenue—and they erred rather against revenue—was a profit of £75,497. Before arriving at that profit, sinking fund was provided to the extent of £51,924. At the end of 1902, sinking fund, depreciation, renewal and reserve fund in regard to the tramways, amounted to £359,744, and the capital expenditure on the same date was £1,832,000. At that date the undertaking was not complete, for the contributions to sinking fund would be larger in the future. The Act authorising the transfer of the undertaking to the Corporation prohibited the Corporation applying any portion of the profits in aid of the rates until the year 1912, but owing to the very satisfactory results of the working, they felt in 1901 that it was not unreasonable that the ratepayers should have some of the profits, due regard being paid to the solvency and efficiency of the undertaking. They applied to Parliament, with the result that in 1902 Parliament authorised the transfer of net profits in excess of £30,000 in relief of rates, provided that the amount transferred should not in any year exceed one third of the net profit. Thus last year the profits were £75,000, and £25,000 was applied to the relief of rates and £50,000 went to renewal, reserve and depreciation. A proper sum was paid by the undertaking for establishment charges. Then the electric supply undertaking was purchased in 1896 from a company, and the result of the year's working in 1902 was a profit of £33,415. Of that, £12,029 was transferred in aid of the rates, and £21,386 went to the renewal fund. Until 1901 nothing was transferred from this undertaking in aid of the rates. The amount standing to the credit of reserve and renewal fund on December 31st, 1902, was £83,244. With regard to the depreciation, he had read the evidence of Mr. Shirley Price, and he felt that Mr. Price was not in a position to deal with it from the point of view of the municipal Corporation. Mr. Price admitted that there was no sinking fund in connection with private concerns, but sinking fund and depreciation were inseparably connected. In the case of a municipality—in the case of a tramway, for instance—the period of the loan was fixed by the Local Government Board, or by Parliament, and that period was fixed in accordance with the life of the undertaking. Now in the case of tramways the overhead equipment must of necessity be kept up to the highest efficiency, and in Liverpool the charges for maintenance of overhead equipment were heavy and continuous. Coming to the generating station the land would certainly not depreciate, and the buildings would certainly have a life equal to the period sanctioned. Therefore, if it were urged because one portion of the plant had deteriorated rapidly, it was the duty of the local authority to make special provision for it, that would lead to a revision with the conditions under which the loan was obtained. The land and buildings would have one period and rails and machinery would have a much shorter one; but pooling the whole he submitted that the evidence of experience went to prove that the period sanctioned by the Local Government Board corresponded very closely with the life of the undertaking. Even in the case of a municipal undertaking which was carried on at a loss, they would have to provide the sinking fund, and assuming that his conclusion was correct, it would not be reasonable to ask the ratepayers to provide a sum for depreciation which was only theoretical, and not yet ascertained, and which in the history of the undertaking might not be necessary.

Replying to Lord Rothschild, Witness said that where street widenings were absolutely carried out for tramways they had charged the tramways accounts to the extent of some thousands of pounds.

Witness was questioned as to whether he did not think that had the tramway and electric lighting companies remained in possession, the same advantages would not accrue. He replied that no doubt the consumption of electricity would have increased, but doubted whether it would have increased so rapidly as to have permitted of such a decrease in price. In the case of tramways, he thought that probably the community would not have been so well served, because the question of dividend would have come in.

From my own experience, I think the Corporations are generally very anxious to show profits for the rates, very much in the same way that directors want dividends?—But Corporations are subject to the pressure of ratepayers.

Mr. Platt Higgins: Do you endorse the statement of the President of your Society, who said, "The £11,700 loss on the 102 municipal electric undertakings ought really to be put as a profit of £190,000, because it included £200,000 for repayment of capital"?—I would not go so far as him on that point.

Mr. W. G. Floyd, one of the elected auditors of Birmingham, complained that the audit he was permitted to carry on was worthless, and while he did not make any imputations whatever as to the honesty of the Corporation and officials, yet he felt that the system adopted made it possible for different Committees to make the accounts appear as they liked. He was strengthened in that opinion by a speech of one of the Councillors, who said that the electrical department of Birmingham had made a profit, but did not show it, because the ratepayers would want their electric light cheaper. He expressed himself in favour of the appointment of a Government auditor.

Mr. H. E. Haward, the Controller of the London County Council, was called, and described the various Acts and conditions under which the Council raised money.

On Monday, evidence was first given by Mr. J. Herbert Tritton, president of the Institute of Bankers, and deputy-chairman of the Central Association of Bankers. He stated that bankers had been concerned with the large growth of local indebtedness mainly in relation to the increase of the whole of the debt in England. In addition there was the question of interference with private enterprise which had been referred to in course of conversations he had had in banking circles. He advised that great strictness should be exercised in the case of expenditure of corporations whose stocks were trustee securities.

Mr. H. E. Haward, the controller of the London County Council, gave further evidence, and said that the general practice of the Council in regard to street widenings where tramways were needed, was to charge one-third of the cost to the tramway account, one-third to the improvement account, and one-third to the local authority. The Council had nothing to do with private companies, although he believed the local authorities made terms with them, and tried to get as much as possible from them for street widenings.

Mr. Alex. Murray, J.P., a member of the Glasgow Corporation, formerly city treasurer, and at present chairman of the Committee on Loans Fund, said the Corporation were the owners of gas, water, electricity, tramway, telephone, markets and park undertakings. The acquisition of these departments had been gradual, and they had been municipalised not with the view of making profit, but rather to provide what was necessary for the proper and efficient equipment of the city in view of modern requirements. Strictly speaking, the Corporation of Glasgow were not municipal traders. Each of their undertakings had been run purely for the benefit of the city, and the profits earned had gone to increase the efficiency of the particular service, and to reduce the debt upon the particular undertaking. It was on this principle that the Corporation took up the question of telephone supply. So long as the telephone service was carried on without requiring the use of the streets, the Corporation took no action in the matter. It was only after the telephone company and telephone experts generally stated that there could be no efficient telephone service without placing telephone wires under the streets, that the Corporation resolved, in accordance with their policy in all other matters, that if the streets had to be opened, they would object to any private company having the right to open them, and would seek the necessary powers themselves. The Corporation extended their gas and electricity mains or their tramways as they were required without the same consideration that a company working for gain would be compelled to give as to whether these would yield an immediate profit. He saw it sometimes contended that, while it may be proper for the Corporation to obtain the Parliamentary powers to construct tramways and electricity works, they ought to lease to a company the operating of the undertaking. They tried that system in Glasgow in the case of the tramways, and found it to be very unsatisfactory to the public. So far as possible, the Corporation had managed all the departments on strictly commercial lines. The books and accounts were kept with the same exactness as those of the very best private concerns or limited companies. The Corporation had always acted on the principle that each department should pay its own way, and that no one department should subsidise another. No charge had ever been made on the rates for any of these undertakings, nor was there any reason to believe that they would not be self-sustaining in the future. In Glasgow they not only provided for a repayment of the debt on all the undertakings of the Corporation by means of a sinking fund, but they provided for the maintenance of the subject out of revenue, and in the tramways department sinking fund and depreciation were provided on a very liberal scale. Glasgow was in the happy position that it could look forward to a time when the tramways and other undertakings would be absolutely free of debt, while they would probably be as valuable as they were to-day, if not more so. The contingency of plant, &c. becoming obsolete had also, of course, to be kept in view, and they did not wish to contemplate the time when there would be no new borrowings, that would imply a check to the prosperity of the city.

Mr. James Dalrymple, accountant to the Glasgow Corporation Tramways Department, said that the department was entirely self-contained, having its own accounting staff, its own power station for the production of electric energy, its own staff for the construction and maintenance of permanent way, also a staff for repairing cars, &c.,

in addition to the large traffic staff. The total staff numbered 3,400. The tramway lines in Glasgow were originally constructed by the Corporation and leased to a company for 23 years from July 1st, 1871. The Corporation commenced to operate the tramways as a municipal department on July 1st, 1894, with horse traction, and the system was converted to electric traction during the summer of 1901. The net amount of borrowing powers on May 31st, 1903, was £2,043,197, and the amount of unexhausted borrowing powers on the same date was £153,885. Additional borrowing powers to the extent of £200,000, had been asked under the Glasgow Corporation Provisional Order of this session. The tramways undertaking was a part of the Common Good Estate of the city, and all loans for tramway purposes were borrowed by the City Chamberlain, who was the treasurer to the Common Good Fund. The loans were borrowed on the security of the Common Good, including the tramways. The net amount borrowed for tramways after the application of the sinking fund as at May 31st, 1903, was £1,889,311. The sinking fund had been handed over by cheque annually to the treasurer to the Common Good, who had applied the amount in the reduction of the tramway debt. The total amount so handed over since July 1st, 1894, had amounted to £155,332. This sum had been calculated, according to the provisions of the Act of 1893, at 2 per cent. on the gross amount borrowed, and was accumulating at 3 per cent. compound interest. This sinking fund would redeem the debt in 31 years from the date of borrowing. The total expenditure on capital account since 1871, when the Corporation first began to construct tramways in Glasgow, had been £2,754,855, and this amount had been reduced to £2,129,512 by the following sums:—Depreciation of permanent way, £201,470; old horse system written off, £180,596; depreciation on present electric traction system, £243,277; total, £625,343. For the year ending May 31st, 1903, the total revenue of the department was £656,572 7s. 11d. The number of passengers carried was 177,179,549, and the average fare per passenger, ·88d. The average total revenue per car-mile was 11·25d. The working expenditure of the same year amounted to £341,870 2s. 11d., and the working expenses per car-mile were 7·40d. The renewal fund now stood at £136,789, and a further sum of £74,038 was charged to revenue to meet the year's depreciation on plant and equipment. There was a credit balance of £224,702, out of which provision to the extent of £124,425 was made for sinking fund, interest, &c., and there then remained a net surplus of £100,276, which, with the exception of £10,000 (which went to the Common Good) was set aside for special depreciation of feeder cables, poles and rosettes, overhead wires, buildings, &c. The tramways department, out of the tramway revenue, kept up the centre of all streets on which the tramways were laid, to a width of 17 ft., and there was no doubt that this was a great saving to the rates. There was no foundation for the statement made by Mr. Kay, that street improvements had been carried out for the benefit of the tramways, and that the cost had been made a charge upon the rates. The valuation of the tramways was made annually by the Assessor of Railways and Canals, who was a Government official, and last year the total rates paid were £16,666. This year the department would be the second largest ratepayer in the city. The principle adopted by the Corporation with regard to depreciation, was to provide out of revenue annually a sum sufficient to reinstate the subject at the end of its estimated life. This sum was always charged against revenue as a working expense. The amount so charged formed a deduction from the capital cost and was applied in the reduction of debt. The annual sinking fund formed a charge against net revenue, and was in addition to the annual amount charged to meet depreciation. The result would be that at the end of the period for the repayment of the debt, the Corporation would have a tramway system in perfect condition, and free of debt. No contributions had ever been made out of the profits of the tramway undertaking in aid of the rate-imposing departments of the Corporation. All the profits had been annually carried to a reserve fund, and the amount at the credit of this fund had been applied partly in renewing the track for electric traction, and partly in writing off the cost of the old horse traction plant and equipment.

Mr. W. Batson, borough treasurer of Blackpool, said that borough owned the gas, electric light and tramways, and he handed into the Committee the volume of accounts published of the Corporation's finances. He favoured the appointment of professional auditors for auditing the accounts, and saw no objection to the appointment being subject to the approval of the Local Government Board.

Replying to Mr. Platt Higgins, Witness said that with regard to the electric lighting and tramway accounts, there was no provision made for depreciation apart from sinking fund, and he considered that assuming the period given by the sanctioning authority for loans was based upon the estimated life of the works for which they were sanctioned, the sinking fund was quite sufficient to supply all necessary depreciation. He differed entirely from the Glasgow witnesses as to the need for depreciation apart from the sinking fund, but it was desirable that the matter should be thrashed out.

Royal Commission on London Traffic.

Sir D. Barbour presided over a further sitting of the Royal Commission on London Locomotion held at the Westminster Palace Hotel on 3rd inst., when further evidence was given by Mr. E. Harpur, the statistical officer of the London County Council.

Witness gave statistics dealing with the number of people entering the central area during the earlier hours of the morning, and referred to the great congestion from omnibus and cab traffic in certain districts. He submitted that the only remedy for this was the prolongation of the trunk railways underground into the central area. Dealing with cheap fares, witness expressed the opinion that cheap fares was the most effective way to get people to live out of the central district. In 1900 Acton was opened up by the electric tramways in connection with the tube railway, and the rateable value of Acton increased 14 per cent. in three years. The opening of one particular district by a tube railway was not an unmixed good, because it would quickly be found that the number of passengers required to be carried within a particular time would exceed the carrying capacity of the trains, and in the district served rents would increase and it would result in overcrowding. If, for instance, a tube railway was opened in the eastern area it would merely aggravate the excess of population there, and therefore there should be facilities offered all round London, so that equal attractions would be given in all directions, and the congestion in the central area relieved. The Council had secured special provisions in nearly all the tube Bills with regard to workmen's fares, but it was now contended that they had no *locus standi* to appear before Parliament on this point, and last year in one case they were precluded from so appearing by the decision of the Court of Referees. He was in favour of a tribunal to deal with the difficulties which arose, but he did not think the L.C.C. would care for such a tribunal having any power over the tramways.

Mr. J. W. Benn, chairman of the Highways Committee of the London County Council, was called. He said that the Council since it was constituted in 1889, had almost uniformly adopted the policy of refusing consent to the tramway proposals of companies on the ground that as the tramway authority under the Tramways Act, it should itself construct and own all new tramways in the county in order to secure continuity in the tramway system of London, and to ensure the work being carried out in a satisfactory manner as regarded the extent of widenings, &c. There had been certain exceptional cases, however, in which the Council had consented to the construction of lines in extension of and supplementing existing systems. In these cases it had required that the date of purchase should coincide with that obtaining with regard to the tramways, of which the new lines had formed a part. Witness proceeded to give particulars of the new tramways in London in respect of which powers had been obtained by promoters under the Council, and also stated the various conditions which were attached by the Council to its consent. There were two important defects in connection with the unsystematic manner in which tramways had been authorised in London. Firstly, certain of the undertakings authorised as distinct systems could only be worked satisfactorily as one undertaking, and the result had been the amalgamation of various lines working under different Acts containing a diversity of clauses governing their control and management. Secondly, owing to the lack of uniformity in the obtaining of legislation, different periods of purchase had been fixed for the same system. Witness went on to detail the history of the negotiations leading to the purchase of the London Street Tramway Co.'s undertaking by the Council, which litigation governed the subsequent purchase of tramways by the Council. Under this arbitration the company only got 10 per cent. of what they asked for, Sir F. Bramwell acting as arbitrator. Proceeding to describe the existing tramway systems in London, witness put in a table showing the tramways constructed in London, with the names of the companies owning them, the mileage inside and outside the county, the districts served by each line, and figures and particulars concerning the relations existing between the Council and each of the companies. The London tramways had been devised and worked as separate units, with no regard to inter-communication, and certain districts had been left practically unserved. There was an urgent need of a physical connection between the lines on the north and on the south of the river. He went on to allude to the steps taken by the Council to extend the tramway system, and the authority obtained for working 35 miles of new tramways electrically. London had got one mile of tramway for every 30,000 of the population, and to get into line with the progress made in the provinces, London ought to have 1,000 miles of tramways instead of 115 miles. Of the 115 miles already constructed, 88 miles were in the hands of the Council, 40 miles of which they worked themselves, and 48 miles of which were leased to the North Metropolitan Tramways Co.

The witness was still under examination when the Committee adjourned.

Walton-on-Thames Electric Lighting.

An important point was raised before Sir R. Gunter's Select Committee of the House of Commons which considered the Walton-on-Thames Electric Lighting Provisional Order, contained in Confirmation Order No. 5, on Tuesday and Wednesday last week. Opposition was raised by the local gas company, who sought to have a provision inserted making the local authority adjust their charges for electric lighting, so that no charge fell upon the rates from the commencement. Such a clause has been inserted in other Bills by agreement. Mr. T. F. Squarey represented the promoters, the Urban District Council of Walton-on-Thames, and Mr. W. M. Paddon appeared for the opponents, the Walton and Weybridge Gas Co.

Mr. Squarey, in opening the case, said the district proposed to be supplied was large in itself, and was a rapidly increasing one. The present cost of street lighting was £750 a year, so that the Urban District Council would be considerable customers themselves. There would be no necessity for them to purchase land for a generating station, or to erect a new generating station to supply power at present, because the Council had in their possession a sewage-pumping station. They had at present two 40-H.P. engines with boilers which were working only six hours a day, and those engines would give any quantity of electricity which could be

reasonably expected to be wanted for some time to come. An estimate had been made of what would be the actual initial cost for the dynamos, &c., and putting them into the sewage-pumping station, which would become the generating station, and the figure, including the distributing mains, would be between £4,000 and £5,000. Prof. Capper had estimated that the maximum would be about 80 KW., and the cost of the plant required to take that load, which would be required at a later period when the demand became greater, together with the buildings, would be about £12,000. He also estimated that there would be a profit of £950 a year, and that within three years the concern would not only be self-supporting, but profitable.

Prof. CAPPER was called and bore out the statement of counsel, and said it was his firm opinion that gas and electricity could run together without doing harm to each other.

Mr. R. H. WEBB, clerk to the Urban District Council, gave evidence as to the nature of the district to be supplied. He saw no difficulty whatever in the Council being able to raise the money, because they had a margin of borrowing powers of £91,000. In 1898 the Council refused its consent to two private companies coming in on the ground that they wanted to do the thing themselves.

The CHAIRMAN: Will you tell us in a straightforward way now; supposing you get this Bill when do you intend to begin the work?—To the best of my belief the intention of the Council is not to hang the matter up, but to proceed with it. I cannot say I am here with an actual resolution that the Council will proceed at once, but I honestly believe they will.

Mr. PADDON asked the Committee to insert the following clause:—"The undertakers shall once in every year after the first year's working of the undertaking, cause to be laid before them a statement and balance-sheet of the accounts of the undertaking drawn up in accordance with the form of accounts prescribed by the Board of Trade for a local authority under the Electric Lighting Acts of 1882 and 1888; and the undertakers shall thereupon fix annually the charges to be made for the supply of energy in the then ensuing year, at such rates (not exceeding the maximum rates specified in this order) so that as far as it is reasonably practicable the revenue for the year shall not be less than the expenditure for that year." He said that the clause was a protective one in the interests of the gas company, whose objections to the order were briefly these:—The District Council was going to trade in electric light just as his clients traded in gas, but with this difference, that the company traded with its own money and paid its own losses, while the Council were going to trade in part with his clients' money against them, and without that clause the company would have the superadded disadvantage of having to pay part of the loss as well. If the district was a rich one, as the promoters said it was, then a profit would be made, and they could come to no harm, but if it was a poor district, then the Council had no right to start the undertaking.

The Committee, before giving their decision, heard the case of the Warmley order, and the arguments of Mr. Balfour Browne, K.C., and afterwards announced that they found the preamble proved, and would insert the suggested clause subject to it reading "after the *third* year's working," instead of the *first* year's working.

ROMFORD AND DISTRICT TRAMWAYS.

THE Select Committee of the House of Lords, presided over by Lord Ribblesdale, on Monday considered the Bill promoted by the Empire Electric Light and Power Co. to construct tramways in Romford and adjacent districts in Essex. The promoters were represented by Mr. Balfour Browne, K.C., Mr. Wedderburn, K.C., and Mr. Hutchinson; Mr. Vesey Knox appearing for the Romford Urban District Council, who opposed some of the clauses of the Bill.

Under the Bill it is proposed to construct about three miles of tramways to be worked by electricity. The line will run through Romford and link up with the authorised and existing tramways at Ilford. In the purchase clause the term of 42 years is substituted for the usual period. The House of Commons Committee has already passed the Bill, subject to the promoting company undertaking certain street widenings at an estimated expenditure of £21,000. The only point at issue before Lord Ribblesdale's Committee was as to whether the company in making the widenings, should be compelled to give a pavement 8 ft. wide.

Mr. VESEY KNOX, on behalf of the Romford Urban District Council, urged this point, but after hearing evidence on both sides, the Committee decided against the District Council and passed the preamble of the Bill.

The clauses were then adjusted, and the Bill was ordered to be reported for third reading.

South Lancashire Tramways Bill.—A Select Committee of the House of Commons, presided over by Mr. E. Bond, on Monday and Tuesday last week, considered the Bill promoted by the South Lancashire Tramways Co. Mr. Fitzgerald, K.C., appeared for the promoters, and said the Bill was to authorise the company to construct tramways and for other purposes. Already the company had 100 miles of tramway sanctioned, 30 of which were being worked, and it was the object of the present lines sought to be constructed, to give additional convenience in working the lines already sanctioned. It was also asked for an extension of two years for the construction of the authorised lines and the acquisition of lands. They also wished to have running powers over the lines of the St. Helens Corporation, which were leased to a company. If this was granted it would connect the South Lancashire Tramways and the Preston and Liverpool Light Railway. The Corporation of St. Helens had leased their tramways, and the lease had 18 years to run, but the Corporation refused to allow the lessors to enter into any arrangements with the company without their consent. The only opponents now were the St. Helens Corporation, who contended that the company should not exercise running powers over their lines except on terms to be settled by the Corporation. The company claimed that the terms should be settled by the Board of Trade. After evidence had been heard, it was announced that an arrangement had been come to by which the company were to have such running powers over the lines of the Corporation as are necessary to conduct a through communication of passengers, passengers' luggage and small parcels, and the company are not to enter into agreement with the company working the St. Helens tramways, except so far as is necessary to give effect to the running powers; any dispute on the matter to be referred to the Board of Trade. The preamble was then declared proved.

Chatham and District Light Railways.—The Standing Orders Committee of the House of Commons have decided that the Standing Orders in the case of the above Bill may be dispensed with, and that the parties be permitted to proceed with the Bill.

New Group.—A Select Committee, consisting of Mr. Ashton (chairman), Major Seeley, Mr. Barran, and Mr. Leveson-Gower has been appointed to consider the following Bills:—Nottinghamshire and Derbyshire Tramways, Rochester Corporation Tramways, Chatham and District Light Railways, and the Hastings Harbour District Railway.

North-Western Electricity and Power Gas.—The Examiner has reported that the Standing Orders not previously inquired into, and which are applicable to this Bill, have not been complied with, and his report will be referred to the Standing Orders Committee.

North Metropolitan Electric Power Supply Co.—The Standing Orders Committee of the House of Lords reports that the Standing Orders not complied with in respect to the petition for this Bill ought to be dispensed with, and leave given for the Bill to be introduced.

Mid-Yorkshire Tramways.—The Standing Orders not previously complied with in respect of this Bill have now been complied with, and the Bill will proceed.

Exeter Corporation.—On Friday the Exeter Corporation Bill came before the Committee presided over by the Deputy-Chairman of the House of Commons. The Bill authorises the construction of nearly seven miles of tramways. Formal proof of the preamble was given, and the Bill was ordered to be reported for third reading.

London, Brighton and South Coast Railway Bill.—Under this Bill power is given to the company to take lands in Deptford for a generating station, and Sec. 13 gives power to work the railway electrically. The Bill came before the Deputy-Chairman's Committee on Friday as an unopposed measure, and was ordered to be reported for third reading.

Blackheath and Greenwich Electric Light.—On Thursday last week this Bill, which is unopposed, came before Lord Morley's Committee of the House of Lords, and the preamble was formally found proved. The Bill confirms an agreement for the transfer to the Blackheath and Greenwich Co. of the undertaking of the Lewisham and District Electric Supply undertaking.

West Cumberland Tramways.—This Bill extends the period for the commencement of the construction of tramways authorised by the West Cumberland Electric Tramways Act, 1901, for extending the area within which the company may supply electricity. It was on Thursday last week before Lord Morley's Committee of the House of Lords, and the preamble was proved and the Bill ordered to proceed.

Newcastle-upon-Tyne Electric Supply.—By this Bill the electricity undertaking of the Walker and Wallsend Union Gas Co. is transferred to the Newcastle-on-Tyne Electric Supply Co., Ltd., and authority is given to the company to supply electricity in bulk to the North-Eastern Railway Co. Formal proof of the preamble was given on Thursday last week before Lord Morley's Committee of the House of Lords, and the Bill was ordered to go to third reading.

Birmingham Corporation Tramways.—The General Powers Bill promoted by the Birmingham Corporation came before a Committee of the House of Commons on Friday and Monday last, presided over by Mr. Heywood Johnstone. Under the Bill the Corporation sought power to work the various tramways in Birmingham by electricity as the leases fell in—in fact, to practically remodel the whole tramway system of the city. There was no opposition to this section of the Bill, which will therefore go forward as unopposed.

Carmarthenshire Electric Power Bill.—This Bill was before the Deputy Chairman's Committee of the House of Commons on Tuesday, and was ordered to be reported for third reading.

Fife Electric Power Bill.—On Tuesday the Fife Electric Power Bill came before the Deputy Chairman's Committee of the House of Commons and was ordered to be reported for third reading.

Metropolitan District Railway Bill.—On Thursday and Friday last week a Select Committee of the House of Lords, under the chairmanship of Lord Ribblesdale, considered the Metropolitan District Railway (Various Powers) Bill. The preamble of the Bill was found proved.

Newcastle-on-Tyne.—A year's return on the traffic of the Corporation tramways has just been issued, and from this it appears that the number of passengers carried was 35,427,070; the miles run 3,615,376, and the total receipts were £159,167. The largest number of passengers carried in one week was the Gosforth Race week in June, when the total was 882,471.

CORRESPONDENCE.

British Industries and Foreign Competition.

[We have received from a usually well-informed correspondent the following report of a speech said to have been delivered at a recent meeting, but as no information is furnished as to names, date, and place, we publish it under all reserve.—Eds. Elec. Rev.]

Ladies and Gentlemen,—You are here at the invitation of myself and my firm to celebrate the extension of our factory, the exhibition of our new fire engine, and to partake of the light refreshments placed before you, but I prefer to consider that the large attendance is entirely due to a desire on your part to encourage British industries; that is to say, industries in which I, and my firm, are interested. Ten years ago we started this new industry; a similar industry had been carried on by other people some 14 years before, but that is of no importance. It was not until we embarked in the industry that it really started, and, therefore, I call it a new industry. Besides, the previous industry was a protected industry, and, as you know very well, protected industries do not thrive, so that it was not until there was a possibility of free trade in this particular manufacture that we could embark in it, and having embarked in it, as you all know, we have had a phenomenal growth, have had to make constant extensions, of which the latest is that you are now present to celebrate; and, being present nominally for that purpose, but really to give your countenance to British industries, I wish to take the opportunity of your assembling to explain to you certain subjects, a clear conception of which is of vital importance to me and to you, and these subjects are mainly political economy and foreign competition:—

1. Political Economy. There are several schools of political economy. One school maintains that the science is an abstruse one, that it requires to be studied from many standpoints, and that the mental attitude of the scholar is the best means of approach to an impartial view of its ramifications and a suitable adjustment of individual rights to the common welfare. The absurdity of any such contention as this must be apparent to you without any words from me. For a complete study of any such problem leisure must be necessary. If a man have leisure, it is obvious he cannot be a manufacturer, and if he is not a manufacturer he cannot be interested in British industries, and is ignorant of the forces which are luring our country to destruction, and rendering it if not impossible, at least highly improbable, that I shall again have the opportunity of inviting you to celebrate in the manner which we are doing to-day, a further extension of these works, or other works, of myself and my firm. Another school of political economists maintains that no one but a manufacturer, a payer of wages, is competent to give an opinion on the science of political economy, or to determine the fiscal policy of our country. Well, Ladies and Gentlemen, I must confess that I had some leanings to that view myself, but I have reflected, and as the purpose of calling you together is to let you have the benefit of my reflections, I will tell you that I cannot throw in my lot with that school. And why? The fact is, manufacturers are sometimes successful. Some succeed so far as to keep a coachman. Some go still further and keep a butler. Now, I am convinced of many things, but my strongest conviction is, that any man who keeps a butler is perfectly incapable of realising the veriest elements of political economy. You ask why I draw the line at the butler and exempt the manufacturer who keeps a coachman? The question is a reasonable one, and I will answer it. If he keeps a coachman he probably keeps a horse, and if he keeps a horse, the market price of corn is a subject of interest, and he is consequently justified in voting against an import duty on corn. But if he succeeds so far as to be able to afford a motor-car, which does not eat corn, he is disqualified from exercising impartial judgment. For that reason I classify chauffeurs with butlers.

Now, some of you are doubtless aware that Mr. Chamberlain has made certain proposals regarding the fiscal policy of this country, and you will all clearly see that Mr. Chamberlain is doubly disqualified, for not only does he keep a butler, but in addition, he was at one time in a position to put the screw on as a manufacturer. Notwithstanding these disqualifications, we have to recognise it as a fact that these proposals have been made and that a decision will have to be arrived at. By whom should such decision be given? I answer unhesitatingly—by those whose experience is such as to place them in the best position to determine questions of political economy—the wage-earners. Take an example from these works, our rates of wages run from 8s. to £3 10s. per week. Those who earn £3 10s. are limited partners in this sense—if the profits are large they get no more than £3 10s., if the profits are small they get less than £3 10s. But 8s. is what is known as the irreducible minimum, and people who have to live on the irreducible minimum have to exercise considerable domestic economy. It is the necessary exercise of this domestic economy which renders the minimum wage-earners the most capable exponents of the intricate problems of political economy, and such capable judges of Mr. Chamberlain's proposals, and therefore, I say, only minimum wage-earners should be allowed to vote on the proposal.

In order that those of you who are thus qualified may understand the bearings of the question, I would point out that our factory is designed to furnish an article which is universally recognised to be far and away superior to anything else of its kind, but it is so placed on the shady side of the street that a minimum of sunshine may have a serious effect on its continuance.

Now, I can produce to you documentary evidence that there is a conspiracy amongst Continental manufacturers to kill this industry of myself and my firm as preliminary to acquiring complete control of all the industries of the country. They propose to do this by an arrangement of spots on the sun which will certainly do their countries more harm than it does ours, but they are content to suffer in order that the consummation of their dearest wish may be attained, viz, the destruction of the industry of myself and my firm.

I say, and I say it emphatically, that it is the duty of the Government to protect the Nation from such a dire calamity as I have indicated. It is the duty of the Government to so arrange matters as to ensure me my fair share (which I will determine) of the home and colonial markets for myself, my firm, and my work-people, and to prevent the importation at home or in the Colonies of other articles at lower prices. There is an impression that lower prices tend to the benefit of the purchasers and the community of which they form a part, but I say that this is a worn out shibboleth and overlooks entirely the interests of myself, my firm, my work-people and our country.

In conclusion, may I be permitted to warn you against the assertions of men who assert anything contrary to that which I have asserted. May I ask you to remember that political economy is not to be studied in the pages of Adam Smith or economists of more recent date. It is absurd to maintain that the irreducible minimum is an important feature, and that those who exist thereon have a vital interest in legislation of an economical nature. It is equally absurd to maintain that the ability of our manufacturers to compete in the world's markets is at all assisted by the free importation of food products. Ponder these things and impress them upon your Trade Union, which you regard as an engine of power, but which I think of only as a safety valve. And when the time comes, vote straight for Protection and Dear Food.

Free Trade or ——?

"Undeluded" is fortunate in exemplifying the well-known fact that political questions, under which head I fear Protection must still be included, are "gey ill" for the temper. Scotch and literal as he is he fails entirely to catch my drift, and would be better pleased with Artemus Ward, who would insert in brackets ("This is wrote sarkastic"). He clearly thinks I was as serious as an owl in asking for a poll tax on foreign engineers as the best way to meet Mr. Byng's desires, and he now asserts that I and others don't know what we want. If I wanted to become more wealthy I could do so in many ways. We all spend money on some form of luxury, and it may possibly be presented to us that given £10 a year to spend, say, on cricket, we might elect to

spend it on a tariff fight with Timbuctoo instead, with a view to ultimate benefit in selling moral pocket handkerchiefs to the untutored natives of that city; we should lose our cricket and exchange it for the luxury of a tariff fight. The truth is, we are in the position of the man who chained his monkey to a tree and got his winter coals free from passing engine drivers. An occasional broken window cost less than coals. But we have begun to look on the coals as a permanent right and to resent the occasional pane of glass, and we suspect that some of the coal is aimed less at the agile gibbon than at the windows. If we removed the monkey the coal would cease to flow in, and the excuse for window breaking would no longer stand good. A friend who is strenuous on tariffs points out the old fable of excess of imports, and loses his temper if told that it is impossible that we have paid for them in gold, though he really does know that we are not a gold producing country, and must have been depleted of that metal long ago. He becomes painfully rude if told that the sum of the imports of all countries is probably returned at a larger figure than the sum of all exports. Whereas, the imports of one country being the exports of others, the items must be identical bar any slight difference due to shipwreck.

It seems doubtful if the question can be discussed amicably, because on both sides men take such narrow views. Mr. Byng wants to protect his goods by compelling me to pay more for them. He has not yet written to ask me to take the place of some of his foreigners whom I, and those like me, think should be taxed, if there is going to be taxing.

"Undeluded" forthwith says rude things of us, on whatever plank we stand. He alone stands superior and knows his own mind. So do we all, but some of us may not be averse from a brush with the enemy, even if we drop a little blood, or forego other luxuries in the scuffle. After all, it may be unwise to fight, and we are told it is unchristian, but there is a certain satisfaction in "landing your opponent on the jaw with your left," as the sporting papers put it, even if he "counters on your bread-basket." It seems to be our precious stomachs that lie at the base of the whole business, either in the immediate present with the Free Trade party, or in the future with the other side. But can we be sure that a tax on food would benefit anyone except the owner of the land, who taxes his tenants all they will bear, and once charged treble the rent which to-day is said to be an overweight as against the free fields of Manitoba, and he would charge it again as soon as he had the opportunity. Could he be blamed for doing so?

Free Trader or ——?

The Dissolution of Matter by Matter.

Solids dissolve solids.
Liquids dissolve solids and liquids.
Gases dissolve solids, liquids, and gases.
(The) Æther dissolves solids, liquids, gases (and æthers) [?]
Where does it end?

Unprejudiced.

July 1st, 1903.

Fuse Wire.

The enclosed figures may be interesting as showing variations that occur in material supplied by well-known supply houses, and illustrate how approximate ordinary fuse wire may be in reference to supposed standards. This material was obtained in small quantities in an ordinary way.

N. C. Woodfin.

Bristol, *July 3rd*, 1903.

TIN FUSE WIRE.

Order per catalogue. S.W.G.	Fusing current.	Diam.	Actual diam.	Amperes = 1,649 d^2. Fusing current.
30	2·3	·0124	·0134	2·5
22	7·7	·028	·035	10·8
18	17·3	·048	·048	17·3
12	55·1	·104	·103—·107	54·3—57·5
8	118	·160	·147—·153	93—98

Diameters taken three times on B. & S. micrometer No. 19.

Street Improvements and Municipal Tramway Accounts.

The evidence before the "Joint Committee on Municipal Trading" is interesting, especially where mention is made of the cost of street improvements being omitted from municipal tramway accounts. The costs of road widenings, &c., are very specially heavy in old cities and towns. At Leeds, for example, I know of two streets—Becket Street and Beeston Road—which are about to be widened, solely on account of the tramways, yet according to the town clerk (Mr. Jeeves), whose evidence by the way reads very contradictory, the cost or part cost of street widenings cannot be included in the tramway accounts except by special power. It would be interesting to know what special power is here referred to, as on the face of it, it reads as if some authority is at work insisting on municipal tramway accounts being drawn up in an incorrect and misleading manner. Mr. Jeeves agrees that certain street improvements should be charged to the tramways, but says this cannot be done save by special power. I have reason to know that some members of the Leeds Improvements Committee are not satisfied with the accounts, and the sooner this evil influence, which consists of misleading tramway accounts, is rectified, the better.

I can assure Mr. Jeeves that if a company had been working the Leeds tramways, "the boot would have been on the other leg." I know of a tramway company at the present moment which cannot begin to even lay the track until it has bought a considerable amount of property along one side of the road, and has further had to agree to pave a county road to keep the Local Council from opposing its Bill. (In so many words, it was "Pave and widen this road or we shall oppose, and bring in evidence the Leeds accounts to show how profitably a municipality can work tramways.") A company's accounts have to carry all these expenses; so why should a municipal tramway undertaking be exempt? But to be told by a town clerk that it requires special powers to enable a municipality to draw up proper accounts is very strange.

E. Kilburn Scott.

The Failure of Wireless Telegraphy in Somaliland.

In your issue for June 26th, under the heading "Telegraph and Telephone Notes," the following appears:—

The *Daily Graphic* of 18th inst. published a letter addressed to them by Mr. Cuthbert Hall, managing director of the Marconi Co., who takes exception to their statement as to the failure of wireless telegraph apparatus in Somaliland Mr. Hall states:—"It is as absurd to take wireless apparatus off a ship and expect it to work well overland as it would be to expect submarine telegraph instruments taken from a land station to work satisfactorily on a ship." We are to understand by this that the mirror speaking and Morse instruments used on cable ships cannot be used to work cables from stations! Mr. Cuthbert Hall knows better than this.

Your comment, "We are to understand by this that the mirror speaking and Morse instruments used on cable ships cannot be used to work cables from stations," is inadmissible. It is never necessary to pursue an analogy beyond a certain point, but, as it happens, my application of the analogy used was literally accurate. I inferred that the *telegraph instruments commonly employed in a land station* cannot be expected to work on a *ship*, not that *telegraph instruments taken from a ship* cannot be expected to work on *land;* and I am surprised that you should have gone out of your way to attempt to demonstrate, by inverting what I said, a verbal inaccuracy which did not exist, and would have been almost immaterial if it had existed.

It seems hardly necessary to point out that there are submarine telegraph instruments commonly used at land stations which are not suitable for use on a ship.

The syphon recorder is very largely used at land stations, but is not suitable for use on a ship, and the mirror galvanometer ordinarily employed in a land station for testing is unbalanced, and will not, therefore, work on board ship.

If it is necessary to discuss further what is at the best a verbal quibble in your Note, I may point out that I am quite aware that the balanced galvanometer used on a ship will, though not commonly employed for such a purpose, work in a land station. I did not infer, however, that ship instruments would not work on land, but that land instruments would not work on board ship. My sole point was to show by a simple analogy that wireless telegraph appa-

ratus, which we have supplied for a certain purpose, is not necessarily suitable for an altogether different purpose.

It is, however, of less moment, perhaps, to show that the analogy was a good one, than to point out the true facts with regard to the remarkable statements which have been made in connection with the alleged failure of the Marconi system in Somaliland.

Lord Selborne stated some time since that the Marconi system had been tried in Somaliland and had proved a failure. We wrote in the *Times* of April 25th :—

> No apparatus has been supplied by our company for use in Somaliland. It is possible that Marconi apparatus has been tried there, but not apparatus recommended by the company as suitable for working overland under conditions likely to obtain in such a country.
>
> Apparatus suitable for working on ships at sea is not necessarily suitable for overland work, nor is apparatus suitable for working overland in a certain country necessarily suitable for working over similar distances in other countries. The conditions under which the apparatus is required to work have to be studied specially in each case. If apparatus supplied, for example, to the Navy, is used inland, success is not merely not guaranteed, but improbable.
>
> We are prepared to supply apparatus suitable for working under almost any given conditions, but it is as absurd to take wireless apparatus off a ship and expect it to work well overland as it would be to expect submarine telegraph instruments taken from a land station to work satisfactorily on a ship.

The denial was couched in these terms, because we thought it possible that apparatus which we had sold to the Admiralty for use on ships had been taken up country in Somaliland. As a matter of fact, however, it is doubtful whether the apparatus used in Somaliland was even apparatus which we had supplied for another purpose.

On an occasion subsequent to that of Lord Selborne's statement, Mr. Brodrick stated in the House of Commons that our company had been applied to for the best installation we could give them for use in Somaliland, and that we were not yet in a position to supply them with the requirements of the field service. This statement, which it will be seen conflicts with Lord Selborne's statement, we absolutely and unequivocally denied. We neither supplied apparatus for use in Somaliland, nor were we asked to supply it.

Marconi's Wireless Telegraph Co., Ltd.,
H. Cuthbert Hall, *Managing Director.*

London, *July 2nd*, 1903.

Wiring Specifications.

Your correspondent, "Wiring Contractor," who complains of a "Consulting Engineer" requiring tenderers to his "specification" to allow for all profit which they expect on the fittings, a net sum for which is provided in the specification, is mistaken, I think, if he supposes that he is required to show the actual profit looked for upon this portion of the work. I know those specifications, and the plan of setting down a net sum for the fittings is adopted to deprive the wiring contractor of his trade discount, and to enable the client to buy fittings at trade prices. The reason the tenderer is asked to include in his main figure the profit he expects upon the fittings is so that he cannot afterwards lay any claim to the trade discount.

I contend that this system is grossly unfair to wiring contractors, and is, if possible, still more unfair to fittings manufacturers. It is unfair to the former because an ordinary retail client is not entitled to buy at trade prices, just because he employs a consulting engineer. And, again, it is unfair to any reasonable tenderer, since there are sure to be others tendering who will allow nothing whatever for profit on fittings, intending to screw it out of the fittings maker, or sacrifice it altogether.

The position in which the fittings manufacturer is placed is still more difficult. The consulting engineer approaches him and asks for a tender at net prices for the fittings, informing him that the wiring contractor's profit is provided for in the specification. The manufacturer then has two courses open to him. He may either tender at list prices, reserving the discount, in which case he will lose the order, as some other maker is certain to tender at the lowest net rates, or he may himself decide to tender at the net trade price. Suppose he takes the second course and is successful in securing the order. After the goods are delivered the wiring contractor comes along and unburdens himself in this wise :—"Oh, yes, of course I know I was supposed to include my profit in the wiring tender, and undertook to do so; but, of course, that was only a blind. *I shall expect the usual trade discount from you, and if I don't get it I shall close my account.*"

This is only one of the little difficulties with which the manufacturers' path is fraught. But the National Electrical Manufacturers' Association is seeing to it, as consulting engineers of the class referred to will later on ascertain, when they find respectable firms declining to quote to specifications of the kind described by "Wiring Contractor."

Morton B. Cotterell,
Manager, Veritys, Ltd., Manchester.

THE CONDUIT v. THE TROLLEY SYSTEM.

Discussion at the L.C.C.—A Deadlock in North London.

An important debate occupying nearly three hours took place at a meeting of the London County Council on Tuesday, when consideration was given to a joint report by the chief engineer and the tramways manager dealing with the relative cost of the conduit and overhead systems of electric traction. The report showed that the cost of construction, equipment and generating plant, &c., for the conduit method amounted to £26,301, as compared with £19,756 on the trolley system, being a difference in favour of the latter of £6,546, or 33·13 per cent. per mile of single line. This report was considered in conjunction with the report of the Highways Committee in reference to the proposed electric tramways in the north of London, of which a list was given in the last issue of this journal.

Mr. S. Low, in referring to the contemplated extensions on the conduit system, remarked that the Council would have to consider whether that method was the best suited for London. In his opinion there were several disadvantages against its adoption. There was, for instance, an enormous disturbance of the streets, and there were certain parts where the conduit could not be constructed, or, at all events, not without great expense and difficulty, which would render it out of the question. He referred to cases where the roads crossed the railways, or bridges passed over canals, as the introduction of the conduit method would mean the rebuilding of the bridges, but in some cases they could not be reconstructed. The Council had overstrained its estimate in regard to the cost of the system. There was the difficulty of flooding, and no experience had yet been had of a snowstorm, when it would be next to impossible to work the tramways. In addition to those defects there was the great difficulty of cleaning the conduit, the sudden extinction of the lamps at crossings, and, finally, the important question of cost. According to the engineer's statement, the additional expenditure could be put down at £7,000 per mile of single track, although the speaker thought the engineer had placed the figures very favourably for the conduit system. With 100 miles of line, which was about the present length of the London tramways, the extra expense on the conduit method would be £1,300,000 for that mileage of double track on the basis of the engineer's figures. But if they had 1,000 miles of tramways, which Mr. Benn seemed to think was necessary, it would mean a difference to the ratepayers of £7,000,000 at the lowest estimate. Besides, about 15 years to 20 years would elapse before the conduit system could be extended throughout London, but what guarantee was there that that method would not be obsolete before the expiration of that period? It might be superseded by automobile cars or the trolley omnibus, and he would not be surprised if in five years' time a tramcar carried its own power by means of accumulators. Under all the circumstances of the case it was necessary for the Council to be very cautious in what it undertook.

Mr. B. S. Straus said that the borough councils would not allow of the introduction of the overhead trolley system. In the particular case of Stepney, which district he represented, the borough councillors asked why they should have overhead wires and other parts of London have the conduit. They were further of opinion that Stepney should not be made more ugly than it is at present. Even a higher authority would come forward, and say that magnetic disturbances should not be set up at Greenwich. The only way to transform the tramways was to adopt the conduit system and ask the ratepayers to bear the expense, which would not be regretted afterwards.

Mr. J. A. Baker remarked that one could understand, from Mr. Low's observations, that he was biassed in favour of one system. Yet the trolley method was being replaced in many cities by the more sightly, safer, and, in the long run, more economical conduit system, and he thought the latter was also about to be installed at Chicago. As far as disturbances of the street were concerned, they only happened once and for all. It was well known that, when once laid down, there was no disturbance of the conduits themselves for 30 or 40 years, whereas the overhead work on the trolley system had to be replaced every three or four years. It had practically been impossible to instal the overhead system in South London, as the authorities were against it within three miles of Greenwich, and that also applied to the East-end of London. The question of flooding had been raised, but although the greatest storm for many

years had recently occurred, the Council's lines were not stopped for a single hour, whereas other systems and the underground railways were blocked and flooded. The speaker next referred to the danger of overhead wires, and quoted a newspaper statement relating to cases of electrolytic action at Leeds. If the overhead method was installed in London, the Council might in time have to replace the gas and water mains, to say nothing of the danger through escaping gas. Discussing the question of cost, Mr. Baker said that the difference between the outlay on the trolley system and the conduit would not exceed £4,000 to £4,500 per mile for the whole of London, but the economy in working and safety would far outweigh and counterbalance any first cost that might be incurred. In conclusion, the speaker declared that the conduit system was profitable, and that 15d. per mile was being earned as compared with the estimate of 1s. per mile made by the Council's officers.

Mr. D. S. Waterlow submitted that although the conduit was the most expensive it was the best system, and he proceeded to show the difficulties which existed for overhead wires in the north of London, owing to the railway bridges of the various companies whose termini are situated in that part of the metropolis. Another serious matter was the lease of the tramways to the North Metropolitan Co. The company said that if the Council adopted the overhead trolley, the work could be put in hand at once, and no difficulties would be placed in the way, and it was intimated that the veto of the local authorities could be overcome. If, however, the council adopted the conduit system, difficulties would arise with the company. There was also the question of disturbance of traffic which might involve the Council in very heavy compensation, and he considered that the compromise proposed by the Highways Committee would represent the wisest course to adopt.

Mr. A. M. Torrance, as representing Islington, opposed the introduction of the trolley system, and appealed to the chairman of the Committee not to press the proposals forward on that occasion.

Mr. R. N. Beachcroft, who considered that the financial question was the primary one, contended that the whole point turned upon the return obtainable from the tramways. The assumption had been that the receipts would average 1s. per mile, and that the expenditure would not exceed 6d. per mile, leaving a profit of 6d. It was probable that the Tooting lines would show the amount of the anticipated result, but unless 6d. per mile net was made throughout London the Council would stand at a loss, as the comptroller had indicated that unless that amount was earned there would not be enough to pay interest and sinking fund charges. In Manchester, Liverpool and Glasgow the working expenses were 8d. per mile, and if the Council's expenses were the same the result would be very serious to the ratepayers.

Mr. J. Burns having defended the conduit system,

Mr. J. W. Benn said the Council had been discussing for a long time a matter over which it had very little control. The London Government Act decreed that the overhead system should not be erected without the consent of the borough councils. With reference to Lord Avebury's letter on the tramways, Mr. Benn referred to the offer made by a syndicate a few years ago to introduce the conduit system, and remarked that if it was good enough for the syndicate it was good enough for the Council.

The discussion on the joint report by the chief engineer and the tramways manager having terminated, the Council proceeded to consider the recommendations of the Highways Committee in regard to the list of tramways published in the last issue of the REVIEW for conversion to electric traction. It was stated during the discussion, that the North Metropolitan Tramways Co. was prepared to favour the overhead system, and it was hinted that the company would oppose the conduit system, and that unless an amicable arrangement could be made, there was no possibility of the North London tramways being converted to electric traction at an early date. The Council eventually adopted the proposals in regard to the projected underground conduit lines, but adjourned the consideration of the recommendations relating to the reconstruction of various lines for the overhead trolley system.

BUSINESS NOTES.

Electric Fan.—We have received from the Electrical Co., Ltd., of Charing Cross Road, W.C., a sample of their latest direct current "Marconi" fan, which, we understand, is driven by the smallest electric motor constructed for use on supply mains. The fan is 6 in. in diameter, and the body of the motor is about 2½ in. × 2½ in. in diameter, mounted on a pedestal, and carrying the guard for the fan blades; the motor is of the three-pole armature, two-pole field type, wound for 110 volts, and runs quite silently and with little current. No starting device is required, the motor quietly running up to speed directly it is plugged into circuit. The whole thing is extremely neat, and a most agreeable "desk companion" in the hot weather—when there is any.

German Electrical Machinery Trade.—So far this year there has been a marked falling-off in the importation of foreign electrical machinery into Germany, the returns for the four months ending with April last showing a total of only 213 tons, which compares with the 583 tons in the corresponding period of last year. On the other hand, there has been a noticeable increase in the exports of German electrical machinery, from 3,563 tons in the first four months of 1902 to 4,005 tons in the four months ending with April last.

Electrical Wares Exported.

Week ending July 8th, 1902.		Value
Adelaide		£70
Alexandria		34
,,	Teleg. mat.	35
Amsterdam		123
Bombay		1,363
,,	Teleg. wire	378
Boulogne		45
Brisbane		30
Buenos Ayres.	Teleg. mat.	331
,,	Teleph. cable.	1,333
Calcutta		1,984
Cape Town		291
,,	Teleg. apparatus	307
Carthagena		28
Channel Islands		66
Christchurch		131
Colombo		60
,,	Teleg. mat.	61
Copenhagen		80
Durban		1,553
,,	Teleg. mat.	289
Gibraltar.	Teleg. mat.	20
Gothenburg.	Teleg. cable	770
Halifax.	Teleg. cable	555
Hamburg		388
,,	Teleg. mat.	30
Lisbon		77
Madras		950
Malta		35
Melbourne		440
Nagasaki		336
Perth		230
Port Elizabeth		110
Rotterdam.	Teleg. mat.	95
St. Petersburg.	Teleg. mat.	125
,,	Teleg. wire	105
,,		95
Singapore		241
Sydney		45
Tokio		677
Wellington		3,242
Yokohama		
Total		£17,100

Week ending July 7th, 1903.		Value
Alexandria		£39
Amsterdam		45
Auckland		135
Bahia		11
Batoum		80
Beira		60
,,	Teleg. mat.	251
Buenos Ayres.	Elec. fuses	28
,,	Teleg. mat.	209
Calcutta		1,435
,,	Teleg. mat.	69
Cape Town		485
Colombo		74
Durban		1,117
,,	Teleg. mat.	126
Dunkirk		20
East London		289
Gibraltar		50
Gothenburg		196
Hamburg		329
,,	Teleg. mat.	140
Lisbon		112
,,	Teleg. mat.	110
Melbourne		825
Monte Video		32
Montreal		68
Napier		10
Odessa		25
Oporto		557
Otago		89
Perth		45
Port Elizabeth		144
Port Said		94
Rio Janeiro.	Teleg. apparatus	2,687
St. Petersburg.	Teleg. cable	95
Singapore		182
,,	Teleg. mat.	26
Stockholm.	Teleg. mat.	76
Sydney		867
,,	Teleg. cable	250
Wellington		1,335
Yokohama		362
Yokosuka		54
,,	Teleg. apparatus	641
Zanzibar		305
Total		£13,114

Foreign Goods Transhipped.

		Value
Brisbane.	Elec. mat.	£13
Melbourne.	Elec. mat.	13
Rio Janeiro.	Teleph. apparatus	229
Yokohama.	Elec. goods	33
Total		£288

Tramway Directory.—The 1903 edition of *Duncan's Manual of Tramways, Omnibuses and Electric Railways* contains, among the new matter, details of 57 new undertakings, 30 of which belong to companies and 27 to municipalities. Wherever possible an analysis is given of the last revenue account available up to the time of going to press. An alphabetical list of directors and officials is given at the end. The *Manual* becomes more important every year in view of the progress of electric traction. Publishers: T. J. Whiting & Sons, Ltd., London. 5s.

Engineering Standards.—Messrs. Robert Atkinson (London), Ltd., of Salisbury House, E.C., the compilers and publishers of the "British Engineering Standards Coded Lists," are preparing, under the authority of the Engineering Standards Committee, the findings of that Committee in a form which is intended to prove of assistance to buyers and sellers of British engineering sections throughout the world. To render the publication a standard work of reference, arrangements have been made to include in it complete lists of the manufacturers and merchants who roll or stock the standard sections. Messrs. Atkinson have issued a pamphlet giving a short history of the Standards Committee and its work. The names of the members of the various Committees are given.

Spain.—Mr. Consul Macdonald, of Bilbao, in his annual report for last year, calls attention among other things to the following:—An important item of present importation consists of incandescent electric light bulbs, of which 224,806 were imported last year, an increase over 1901 of 186,777. These were all of German origin, and of from 5 to 25 candles. The wholesale price f.o.b. was 35 frs. (28s.) per 100 bulbs, the customs duty payable thereon being 20 pesetas (11s. 8d.). The native manufacture is not yet of first rate quality, but will probably improve. Retail prices for native bulbs are from 70 to 75 pesetas (£2 1s. to £2 4s.) per 100. The Germans have also taken a firm hold of the trade in electrical appliances, and owing principally to the resources and enterprise of a well-capitalised company in Bilbao, have secured something like a monopoly of all large installations. This is a matter of considerable interest to makers of copper wire. It may be added that the Consul at Corunna also calls attention to the opportunities in Spain for British makers of electric appliances.

Holidays.—Another of the G.E. Railway Co.'s attractive little holiday booklets, issued from 30, Fleet Street, E.C., is that describing some inexpensive tours in Belgium and the Ardennes. Some tinted illustrations of characteristic scenes are quite alluring.

Forthcoming Book.—We are informed that a book on "Practical Construction of Electrical Tramways," by Mr. W. R. Bowker, is shortly to be published by Messrs. Spon.

Swindon Electricity Works.—In our reference to the opening of this station we inadvertently omitted to mention that the work of lighting the station itself was carried out by Messrs. R. J. Nicholson & Co., of Manchester.

Catalogues and Lists.—A circular price list of new flexible cord—"C.M.A. Flexible"—has been issued by W. T. HENLEY'S TELEGRAPH WORKS CO. The cord is made to a special specification adopted by the Cable-Makers' Association to meet the stringent regulations of insurance offices and other authorities. It is insulated with pure and vulcanised india-rubber, and gives a minimum insulation resistance of 600 megohms per mile at 60° F. after 24 hours' immersion in water and one minute's electrification, and is tested with 1,000 volts alternating current for 15 minutes.

MESSRS. JAMES PROCTOR, LTD., issued last week a new catalogue of their improved patent shovel stoker and moving fire-bars for colliery use, and also for steel and iron works. The firm were exhibiting the apparatus at the Agricultural Hall Colliery Exhibition, which closed on Tuesday last. The catalogue gives a very full account of the stoker, and tests which have been made upon it. A list of 260 of the furnaces which are doing service in collieries in the Midland district, 340 in the Yorkshire district, 150 in the Newcastle district, and 240 in electric stations in different parts of the kingdom, is arranged over some 16 pages.

The B.T.H. Co.'s new list (No. 145) describes a combined switch and cut-out which they have specially designed for car lighting circuits. It consists of a single-pole snap switch with an extra long break connected in series with an enclosed fuse. The switch is rated at 3 amperes, and will break the current at 600 volts without drawing an arc sufficient to damage the contents. The fuse, which is held in spring clips, is of the enclosed type, and it is said will open a short circuit on a 600-volt line without arcing or straining the porcelain.

MR. G. BRAULIK has placed before us copies of his new lists of "Simplex" telephones for fitting to bell circuits, electric cooking and heating apparatus, and one of his revised catalogues and price lists of telephones and accessories. Copies of any of these lists may be obtained on application at 217-8, Upper Thames Street, E.C.

MESSRS. MATHER & PLATT, LTD., of Salford Ironworks, have sent us a copy of their new Feed Water Filter Catalogue. The apparatus is described with the aid of sectional and other illustrations, and an imposing list of electric lighting works, mills and factories where it is now in operation or in course of construction is given.

An 8 pp. catalogue of Zephyr electric fans, grinding and polishing machines, ventilators, and small-power continuous-current motors has been issued by MESSRS. E. GOOSSENS POPE AND CO., of Guildhall Chambers, E.C.

The GENERAL ELECTRIC CO., LTD., has just issued a number of new publications. No. P 1,023 details, with illustrations and prices, the "Witton" continuous-current motors, of latest design with interchangeable parts; No. K 1,036 describes the "Little Geeko" telephone—a cheaper form of the well-known "Geeko" apparatus; the July "Progress" sheet is devoted to a number of electric light fixtures, motor-car switches, coils, &c.

From CALLENDER'S CABLE & CONSTRUCTION CO. we have received a handsome collection of photographic reproductions showing cable-laying operations being carried out by Callender's employés in many parts of the globe. If we mention views from Christiania, Copenhagen, Gibraltar, Barcelona, and Madrid among Continental cities; also Durban, Sheba gold mines, Colombo, Calcutta, Alipure, Sydney (N.S.W.), Auckland (N.Z.), and Mexico, in Colonial and other parts, we think we sufficiently show how widely known is Callender's Cable Co. and its work.

Many designs of cast and wrought-iron stairways for electric power stations, engine rooms, public institutions and factories, are well shown in a large catalogue which has just been issued from the press by MESSRS. ROWLAND CARR & CO., of Lime Street Square, E.C. Electrical engineers, surveyors, architects and others, in the course of whose work the very important considerations of fire prevention are continually to the fore, will find the designs which Messrs. Carr have prepared at great expense, of some service to them.

A revised pocket price list of "Norwich" type four-pole electric motors (semi-enclosed) has been received from LAURENCE, SCOTT AND CO., LTD.

From the PEARSON FIRE ALARM, LTD., there has come to hand a small pamphlet, giving in catechetical form an explanation of the Pearson system and its merits, also a list of some premises where it is employed.

Electrical Transmission for Slate Quarries.—The Park & Croesor Quarry Co. are now putting down an electrical generating plant for supplying power throughout their quarry at Penrhyndeudraeth, N. Wales. Messrs. Gilbert Gilkes are supplying the turbines, the whole of the electrical work being carried out by Messrs. Witting, Eborall & Co., Ltd., of Temple Bar House, E.C. The generating station is equipped with a turbine-driven three-phase alternator, capable of giving 200 KW. at a pressure of 2,750 volts. The exciters are separately driven, and the installation includes a high-tension power-transmission line for supplying power to the quarry for driving motors, haulage, and pumping gear, and one locomotive, all supplied by the above firm. The whole of the work is being carried out to the specification of the quarry company's engineer, Mr. M. Kellow.

Manchester Corporation Sub-Stations.—We are informed that all the measuring instruments on the Ferranti low-pressure boards, in the 10 sub-stations included under Mr. Metzger's scheme, were supplied by Messrs. Nalder Bros. & Thompson, Ltd., as sub-contractors.

N.T. Co.—The National Telephone Co. has purchased Gresham Hall, Gresham Road, Brixton, for the purposes of its business in the district.

Trade Announcements.—Messrs. Bruce & Co., electrical engineers, of 2, York Buildings, Hastings, have acquired the electrical business carried on by the Southern Electrical Installation Co., Ltd., of 9, Claremont, Hastings. The business will be amalgamated with that at 2, York Buildings.

In consequence of the extensive damage done by the recent fire at their premises in Queen Charlotte Street, Bristol, Messrs. Edwards and Armstrong, electrical engineers, have removed their business to the Broad Weir Engine Works.

Engineering Undertakings, Ltd., has changed its address from 78, King Street to 14, College Land, St. Mary Street, Manchester.

Mr. F. Winter, of 8, Redcross Street, E.C., announces that he has just opened the agency of the American Hard Fibre Co. for the United Kingdom and the Colonies. The company have not heretofore opened a direct agency of their own over here. A large stock has been put down in London, and a further facility has been created by providing for the manufacture of special fibre articles on this side at short notice. Mr. Winter will continue to hold, as for the last 24 years, the sole agency for the United Kingdom and the Colonies, and the management of the London warehouse of Messrs. Dr. Heinr. Traun & Sons (formerly the Harburg India-Rubber C. Co).

Messrs. Evershed & Vignoles, Ltd., have removed to their new factory at Acton Lane Works, Chiswick, W., where their head office is also situated.

Erratum.—After part of this issue had gone to press, it was noticed that on p. 47, line 17 from the foot of the first column, the date should read February 4th, 1903, instead of October 4th.

Annual Outings.—The annual beanfeast of the County of London and Brush Provincial Electric Lighting Co., City Road (Northern District), was held on Saturday, June 27th. The party went by train to Maidenhead, where a cricket match between the generation and distribution departments resulted in a win for the latter after an exciting game by 53 to 42. After dinner the party went by steam launch to Molesey, a break for tea being made at Bell Weir Lock, Egham, and a pleasant day was finished up with a tramcar ride to Shepherd's Bush, where the party broke up. The expenses were borne by the men themselves, with a grant from the company and subscriptions from the engineers. No subscriptions whatever were asked for or received from contractors or others outside the firm. This has been the custom of the company for several years.

The annual beanfeast of the Western Electric Company took place on Saturday, June 27th, when some 130 of the employés drove *vid* Eltham, Chislehurst, Pollhill and Dunton Green to Host Holland's at the Lime Tree Hotel, Sevenoaks. An excellent dinner was prepared for them there. The chair was taken by Mr. A. T. Tarney. After dinner the usual toasts were given, including that of "The Firm: its increased prosperity." Mr. Kingsbury, the managing director, who was on the Continent, wrote hoping they would spend a happy day. He said he should drink "Success to the Firm" at 3 p.m. in anticipation, and this was exactly the time the party were doing so. A programme of sports was then gone through.

Germany.—The report of Messrs. Felten & Guilleaume, of Mulheim-am-Ruhr, for the last financial year shows a net profit of £122,153 as compared with £88,073 in the preceding 12 months. A dividend of 5 per cent. is being declared.

Books Received.—"Engine Tests and Boiler Efficiencies," by J. Buchetti. Westminster: Archibald Constable & Co., Ltd., 2, Whitehall Gardens. 10s. 6d. net.

"Institute of Marine Engineers' Transactions, Session 1902-1903." Vol. xiv. Stratford: 58, Romford Road.

"Duncan's Manual of Tramways, Omnibuses and Electric Railways, 1903." London: T. J. Whiting & Sons, Ltd., 7A, South Place, E.C. 5s.

Dissolutions and Liquidations.—A meeting of Mercier's Patents, Ltd., was held at Salford on June 3rd, at which it was resolved to wind up voluntarily with Mr. Maunsell Mercier as liquidator.

The partnership of Sir J. Wolfe Barry, H. M. Brunel, C. A. Brereton, G. E. W. Cruttwell and K. A. Wolfe Barry has been dissolved so far as regards H. M. Brunel. The remaining gentlemen will continue the business under the same style of Sir John Wolfe Barry & Partners.

The Electrical "Lumiscriptor" Co. are winding up voluntarily with Mr. R. Warner, 10, Walbrook, E.C., as liquidator.

Bankruptcy Proceedings.—The creditors of Alexander John Noble, lately trading as an electrical engineer at 567, Battersea Park Road, S.W., met on Thursday at the London Bankruptcy Court before Mr. G. W. Chapman, Official Receiver, when accounts were submitted showing debts £262 10s. 9d., and assets £1 2s. The debtor states that in 1900 he commenced business at 2, Howards Road, Plaistow. This venture was successful, and the debtor in October, 1901, took his father and brother into partnership. They then purchased the business at 567, Battersea Park Road, from Messrs. Frost & Knight for £230, and put in cash, stock and book debts to the value of about £250. They carried on the business for five months only, and the debtor asserts that its value was totally misrepresented by the vendors. The Plaistow business was carried on by the debtor and his partners until April, 1902, when it was sold for £45 to Miss E. J. Simmonds, for whom the debtor has since managed it. He attributes his failure to misrepresentation of the value of the Battersea business and to the withdrawal of support by his father and brother. In the absence of any offer, the case was left

in the hands of the Official Receiver to be wound up in bankruptcy, the public examination having been fixed for July 31st. The principal unsecured creditors are as follows:—Frost & Knight, Battersea, £194; Edison & Swan Co., £32; Brockie-Pell Arc Lamp Co., Ltd., £15.

The public examination of Harry South, electrical engineer, late of Garrick Street, Covent Garden, W.C., was held on Tuesday at the London Bankruptcy Court before Mr. Registrar Gifford. The debtor applied to pass upon accounts showing total liabilities £1,404 10s. 6d. (unsecured £619 3s. 4d.), and net assets £30 4s. 6d. In the course of his evidence the debtor said he commenced business in 1884, and traded alone until the end of 1899. Mr. Tilney then joined him as a partner, and it was decided to convert the business into a limited company, which was registered in the name of Harry South & Co., with a nominal capital of £10,000. Asked why they tarded as a company instead of a firm, the witness said they were strangers to each other, and adopted the plan for their mutual protection. The business was then solvent. Witness and his partner acted as joint managing directors of the company at a salary of £5 per week, until the end of 1901, when the company went into liquidation. The creditors of the company had already received 13s. 4d. in the £, and would probably receive payment in full. Witness and another person in January, 1901, obtained an option for the purchase of the Royal Music Hall, Holborn, at the price of £52,000. The Royal, Ltd., was formed to take over the property, and in March, 1902, witness launched an action to recover his share of the purchase consideration, but a verdict was given against him. He attributed his failure to depreciation in the value of the shares of the Harry South & Co., Ltd., and to his liability for the defendants' and his own costs in the before-mentioned action. This was his first failure. The examination was concluded.

For Sale.—Certain engineering plant, machinery, tools is to be offered for sale by auction at Huddersfield, by Messrs. G. Tinker & Son, on July 16th. See our advertisement pages to-day for particulars.

ELECTRIC LIGHT AND POWER NOTES.

Arbroath.—The Electric Lighting Committee of the Council has had under consideration a report which showed that the cost of providing electric light in the compulsory area under the provisional order would be £20,000, and that at the end of two years it would be optional on the part of anybody outside of the compulsory area to apply for its extension, which would bring the cost up to £40,000. After discussion, it was agreed by a majority, on account of financial reasons and the prospect of the adoption of an extensive water scheme, to arrange the best possible terms with a company for the carrying out of the work.

Batley.—The T.C. has received sanction from the L.G.B. to raise a loan of £5,300 for a refuse destructor in connection with the electricity works.

Benwell.—At a recent meeting of the U.D.C., it was, after considerable discussion, decided to accept the offer of the Newcastle Electric Supply Co., to supply electricity at a maximum average cost of 4d. per unit, subject to a satisfactory agreement in regard to street lighting.

Berlin.—The administration of the Prussian State Railways has decided that after the 15th inst. all trains running on the suburban line between Berlin and Lichterfelde shall be drawn by electricity. The steam engines will be entirely banished from the line after the 15th inst. Each ordinary train consists of two long coaches, one second and one third-class, each with separate compartments for smokers.

Birkenhead.—The Council has authorised an application to the Board of Trade for a prov. order to supply electricity to the townships of Upton and Prenton, outside the borough boundaries.

Blackpool.—A L.G.B. inquiry has been held into the application of the T.C. for a sum of £7,000 required for new cooling towers and cable extensions, in connection with the E.L. department.

Blaydon.—The County of Durham Electric Power Distribution Co. has notified the U.D.C. of its intention to apply to the B. of T. for a prov. order to supply the district. A syndicate entitled the Priestman Power Co., Ltd., has been formed, and has opened negotiations with the Council for supplying electricity.

Bognor.—The E.L. Committee has been informed by Messrs. J. & J. S. Enright that Messrs. F. Suter & Co., Ltd., are prepared to enter into an agreement with the Council to carry out the electric lighting order on the following terms:—The contractors to submit a tender for carrying out the work in accordance with the specification prepared by Messrs. Enright; the Council to borrow and pay to the contractors the cost of the undertaking as set forth in the tender submitted by the contractors; the contractors to carry on the undertaking on behalf of the Council, providing a supply of electricity for public and private purposes at a price not exceeding: (*a*) for private lighting, 6d. per unit; (*b*) public lighting, 4d. per unit; (*c*) power, 2½d. per unit; the contractors to pay all expenses connected with the running of the undertaking, including interest and sinking fund on the amount borrowed by the Council; the contractors to receive all revenues arising from the sale of electrical energy, meter rents, &c.; no extensions to be carried out without the permission of the Council; all losses to be paid by the contractors, but any amount so expended by them to be refunded to them out of the first profits; the profits to be divided equally between the Council and the contractors; Messrs. Enright's fees to be paid by the contractors; the Council not to be bound to take over the undertaking at any time; the Council to have the option of taking over the undertaking by giving one year's notice of its intention to do so; if the installation has been run at a loss, the Council to pay to the contractors the amount of such loss on taking over the undertaking; if the installation has been run at a profit the Council to make no payment whatsoever for taking over the undertaking; the Council to retain the prov. order. After discussing the question with Mr. J. S. Enright, the Committee decided to recommend the Council to adopt means to carry out the said scheme.

Bradford.—At a meeting of the Electricity Committee, it was decided that the reduction from 4½d. to 4d. per unit for lighting should operate from the 1st inst. The reduction for motive power—minimum 1½d. per unit, maximum 2d. will come into force on November 1st. The Committee is still making efforts to increase the price charged to the Tramways Committee from 1d. to 1½d. per unit.

Brentwood.—The Sir Hiram Maxim Electrical Engineering Co. has given notice of its intention to apply for a prov. order to supply electricity in Brentwood.

Bridgend.—At the Brigend County Court, before Judge Williams, a case has been heard in which Mr. Brogden, of Ferry Side, was sued by Mr. Morgan John, a local tradesman, for £32 17s. 6d., damage sustained by him through defendant ceasing to supply him with light. According to plaintiff, Mr. Brogden, through Mr. J. H. Clarkson, contracted to supply him with electric light at a charge of a guinea per annum for each lamp downstairs, and half a guinea for each lamp upstairs. This was in April, 1900; in August, 1901, the light ceased without any notice, and on his writing for an explanation, no reply was vouchsafed. The wires, lamps, &c., became as a consequence useless, and he experienced £10 of other damage. Plaintiff said that he was aware that the light ceased because of a breakdown in the machinery. He had no agreement as to notice, nor did he understand that the current supplied to him was merely what was to spare from the hotel, and could be cut off at any moment by the defendant. For the defence, Mr. Clarkson, Mr. Brogden's agent, was called, and he said that the light supplied plaintiff was the margin left after supplying the Esplanade Hotel, and was supplied to him on the distinct understanding that it could be cut off at any time. Other people had been disconnected at a moment's notice. His Honour said that if there was an obligation on Mr. Brogden to continue the supply, it was strange that there was no written agreement. The fact that there were other people who had accepted peremptory notice, was inferentially conclusive, and he gave judgment for the defendant.

The D.C. have agreed not to alter the rent of electric meters from the present charge on their cost of 10 per cent. per annum, and to sell them to consumers wishing to buy at a premium of 10 per cent. on the cost price. Correspondence has taken place with the South Wales Electric Power Distribution Co. as to allowing the latter to supply light as well as power to large firms with whom power was the first consideration, provided they made no charge for transforming the current supplied to the Council. It appeared that at the time the matter was opened the company's charge for energy was 2¼d. per unit and ¼d. for transforming, and that before the arrangement was agreed upon it was reduced to 1⅞d., and ⅛d. for transforming; and the matter was allowed to drop, as the Council, in consideration of the reduction in price, did not intend to press the demand. But it was now held that the Council got no equivalent in consideration for the valuable privilege granted the company, and negotiations with the company were ordered to be resumed.

Clacton-on-Sea.—The Empire Electric Light and Power Co., Ltd., has notified the U.D.C. that it intends to apply for a prov. order to supply electricity within the Council's area.

Clayton.—The Empire Electric Light and Power Co. has given notice that it intends to make application for a provisional order to supply electricity within the Council's area.

Clevedon.—Notices have been served upon the U.D.C by four companies intimating that special prov. orders for electric lighting are to be applied for.

Croydon.—The returns for the past year of the electrical department show that the total receipts amount to £40,154, as compared with £27,483 last year, and the gross profit to £18,200, as compared with £12,850 last year.

The number of 8-C.P. lamps connected was 96,479, and the units sold 3,131,841, an increase of 73 per cent. on the previous year.

Dudley.—The returns for the year of the E.L. department show a total expenditure of £67,392. On the supply account for last year the expenditure has been £4,409, and the income £8,929, leaving a gross profit of £4,519. Of the gross profit £1,429 has been absorbed by interest on mortgage loans, £1,375 by repayment of loans, £526 by banker's charges, leaving a net profit for the year of £1,186.

East Dereham.—The U.D.C. has received from the Southern District Electricity Co. notice of its intention to apply for a prov. order to supply electricity within the Council's area.

Falkirk.—In connection with the Scottish Central Electric Lighting Order, it was reported that the negotiations with the T.C. were off, but last week the Council received an intimation that the promoters were open to adjust protective clauses, and on 3rd inst. the town clerk left for London to consult with the Parliamentary agent.

Freebridge Lynn.—Lynn T.C. has informed the R.D.C. that it intends to apply to the B. of T. for a prov. order to supply electricity in the parish of Gaywood.

Frome.—The Western District Electric Distributing Corporation has notified the Council that it intends to apply to the Board of Trade for a provisional order to supply electricity within the area.

Gateshead.—The T.C. has received a proposal from the County of Durham Electric Power Distribution Co. to make reductions in the price of energy, if the Council will extend the period of the prov. order and grant other facilities.

Gorton.—After considering the question of the town being supplied with energy for lighting and power by Manchester Corporation, the U.D.C. has deferred the matter for further consideration.

Grays.—On July 1st a L.G.B. inquiry was held relative to the application of the U.D.C. for a loan of £650 for E.L. purposes. Only formal evidence was given, and there was no opposition.

Grimsby.—In answer to a query of the T.C., the G.E. Railway Co. have intimated that they contemplate supplying electricity themselves to the Docks and Pontoon. It has been decided to interview the general manager on the question, and as to lighting the railway station. It is pointed out that the company cannot supply customers with electricity, although they can use it themselves.

Halifax.—At the recent Local Government inquiry respecting the Corporation's application to borrow £20,000 for extending the electric lighting undertaking, and £3,975 for street improvements, the Halifax Ratepayers' Association offered some opposition on the ground that there had been an inadequate return on the large expenditure, and further that the Corporation had made a great mistake in spending £27,000 on a transforming station at Hebden Bridge, the latter town having decided to have a supply of its own.

Heligoland.—A new lighthouse has been put into operation, from which a 30 million c.p. beam of light is projected. The source of energy is electrical, and the German engineers have adopted parabolic mirrors of glass, in preference to the costly Fresnel lenses used in some of the French lighthouses.

Herne Bay.—The U.D.C. has received notices on behalf of Sir Hiram Maxim and a Birmingham syndicate, of their intention to apply to the B. of T. for prov. orders to supply electricity in the area.

Hove.—The prov. order obtained by the Corporation will lapse unless something is done very soon to carry it into effect. The Hove company's area does not include Aldrington, which has recently been incorporated with Hove. The Council will probably lay its own mains and purchase energy in bulk from either the Brighton Corporation or the Hove company, and the competition thus engendered will probably result in very favourable terms being obtained by the Corporation.

Overhead Conductors.—A curious accident illustrating the danger arising from the great number of electric light and power wires which are strung along the streets of American cities is said to have occurred in Pittsburg, whereby four persons were killed. One of the worst thunderstorms that have visited Pittsburg for years had just blown over. A flag waving from the window of a house had become saturated with rain, and its weight broke the pole from which it was suspended. The pole snapped an electric light wire, the end of which trailed in a puddle of water left by the rain. A man who started to cross the street stepped in the pool and dropped dead. At that moment a carriage drove into the pool, and the horse fell dead. The occupants of the carriage jumped out into the water, and were also killed instantly. The daily Press is responsible for this narrative.

Kingsbridge.—The Southern District Electricity Corporation has given notice that it intends to apply to the Board of Trade for permission to supply electricity within the area of the U.D.C.

Kingston-on-Thames.—A L.G.B. inquiry has been held into an application by the Corporation for sanction to borrow a further sum of £7,784, for the purposes of the electric lighting undertaking. There was no opposition. The amount is made up by excess on buildings, £1,448; on machinery (exclusive of street lighting) £1,714; on street lighting machinery, £39; on street lighting, cables and lamps, £178; mains, cables, sub-stations and transformers, £1,836; consumers' services, &c., £2,124; and miscellaneous items, £445.

Little Lever.—The D.C. has received an intimation that the Lancashire Electrical Power Co. is preparing to give a supply to the district.

London.—Marylebone.—The L.C.C. having refused to sanction the raising of a loan by the Borough Council for the purchase of the Metropolitan Electric Supply Co.'s undertaking, the company brought an action to compel the payment of the £1,212,000 awarded by the arbitrator. Judgment was given in the company's favour for specific performance of the contract by December 31st next, but certain details of the purchase were referred back to the arbitrator. (See p. 46.)

Hackney.—In a recent report the Electric Lighting Committee of the B.C. states that in spite of the excellent progress which the undertaking is making, the day load has not grown in due proportion to the lighting load. Shoreditch and Stepney have load factors of 21·29 and 22·74 per cent. respectively, as compared with the Hackney load factor of 15·36 per cent. The Committee recommends that the following tariff come in force for power from November 1st:—Up to 1,000 units per quarter, 2d. per unit; in excess of 1,000 units per quarter, 1½d. per unit.

Islington.—As a result of the reconsideration of cable tenders, that of Messrs. British Insulated and Helsby Cables, Ltd., at £5,350, was accepted. It was further decided to accept the tender of the Electrical Construction Co., Ltd., for the supply of 37 30-kw. transformers at £2,966.

Long Eaton.—A L.G.B. inquiry has been held into the application of the U.D.C. to borrow £5,000 for electrical purposes. There was no opposition.

Maesteg (Glam.).—The D.C. is now negotiating with the South Wales Electrical Power Co. for the supply of electricity for public lighting.

Maidenhead.—The T.C. has decided to apply for a prov. order to supply electrical energy to the parishes of Bray, Taplow and Cookham.

Malling.—The Kent Electric Power Syndicate and the Kent Electric Power Co. have given notice to the R.D.C. that it is proposed to apply for a prov. order authorising the supply of electricity for lighting and other purposes within the Council's area.

Manchester.—According to the accounts of the Electricity Department the sales to the public last year were 10 per cent. above those for the preceding year. On the traction account there has been a great development, the increase being 309 per cent. in the course of the year. In round figures the units sold were 17,400,000, as against 10,500,000 units in the year ended March 31st, 1902. The recent reduction in the price of energy for power purposes was expected to bring about a large accession of customers, and negotiations were practically completed with one firm alone which would guarantee a sale of three-quarters of a million units per annum.

Naval Dockyards.—Among the items covered by the recent naval vote is a provision for equipping the Admiralty naval establishments throughout the world with electric light and power plants.

Newport (Mon.).—Negotiations are in progress between the T.C. and Messrs. John Lysaght, Ltd., proprietors of the largest rolling mills in the world, these being situated at Newport, for the supply to the firm by the Corporation of a large amount of electrical power for driving additional machinery which is being laid down.

Northallerton.—The U.D.C. has accepted the tender of the local electric lighting company for public lighting on the following terms:—Arc lamps, per 100 hours each, 15s. each; 32-c.p. incandescents, 100 hours, 3s.; ditto, for side streets, 3s. 9d.; Main Street and South Parade, arcs, 15s.; 32 c.p., 3s.; 16 c.p., 2s. 6d.; side streets, 4s. and 3s. each.

Rainham.—The Kent Electrical Power Co. and the Kent Electrical Syndicate have given notice that they intend to apply for a provisional order for powers to supply the parish with electric light and power.

Ramsgate.—The T.C. has applied for an extension of the Council's prov. order to enable the necessary works provided for, in the leasing of its powers to the Isle of Thanet Co., to be carried out. The Ramsgate and District Supply Co. has given notice of its intention to apply for a prov. order for the borough. (It was understood that the above emanated from Messrs. Edmundson's Electricity Corporation.)

Redditch.—In connection with the recent decision to obtain expert evidence on the condition of the electric lighting scheme, Messrs. Burstall & Monkhouse, of London, were engaged to make an inspection, and their report was read at a meeting of the D.C. The experts are of opinion that an error of judgment was made in installing a high-pressure alternating current system, but the cost of changing the system from alternating to continuous would be prohibitive. Of the four engines running at the station, three are running satisfactorily, but the vertical engine is very unsatisfactory. The experts note that the number of 8-c.p. lamps connected to the mains has steadily increased, especially since August of last year; also that there has been a steady decrease since 1900 in the "cost per unit sold." They are of opinion, however, that there is "room for further improvement in this direction." Not only is the consumption of fuel high, but the cost is too high. What the Council needs now, conclude the experts, is more customers.

Pudsey.—The T.C., whose prov. order expires in August, has received an intimation that a private company intends to apply for powers to supply the district with electricity.

Ripon.—The B. of T. has informed the T.C. that the E.L. Order, 1901, does not contain any provision enabling the Corporation to transfer the undertaking to a company. The order expires on July 26th, but providing the Board is satisfied that the Council intends to take steps to carry out the compulsory works at an early date it will consider the postponement of the revocation of the order.

St. Asaph.—The Board of Guardians has decided to have the electric light installed in the Workhouse and new Infirmary.

Sittingbourne.—The Empire Electric Light and Power Co., of Romford, has intimated to the U.D.C. its intention to apply for a prov. order for electric lighting in the Council's area.

Sleaford.—The L.G.B. has forwarded to the U.D.C. permission to borrow £1,925 for E.L. purposes.

Spain.—Rapid progress is being made with the installation of the plant to utilise the water-power of the Pasteral Fall on the River Ter (Gerona). About 1,600 H.P. is available, and the electrical energy generated is to be transmitted to Gerona for power purposes.

Spalding.—At a recent meeting of the Urban Council a letter was read from the Electric Supply Co., intimating that they proposed to apply to the Board of Trade for an order to supply electric light to the town. No action was taken by the Council (who are the owners of the gas works), it being stated that they could successfully oppose the application, provided they undertook to supply electric light within two years.

Spennymoor.—The U.D.C. has decided to utilise the electric light for street lighting. The tenders are said to have been as follows:—Spennymoor Gas Co., £2 12s. 6d. per lamp; Tudhoe and Sunderland Bridge Co., £2 18s. 6d. per lamp; Northern Counties Electricity Supply Co., £2 3s. 6d. per lamp.

Stourbridge.—The U.D.C. held a special meeting on the question of the electric lighting of the Council's district on Monday evening. The agenda included items respecting the revocation or alteration of resolutions relative to the utilisation of the provisional order the Council obtained before the litigation with Mrs. Cathcart; and as to a contract with the Midland Electric Corporation for Power, Ltd., for the supply of electricity in the urban district. After two hours' discussion in committee, the clerk was authorised to apply to the Board of Trade with a view to assuring the non-revocation of the prov. order.

Stourport.—The Shropshire and Worcestershire Electric Power Co. has given the U.D.C. notice of its intention to apply for a prov. order to supply electricity in the Council's district, adding that if the Council wished to obtain its own order it would be willing to supply electricity in bulk. The General Purposes Committee is considering the matter.

Swansea.—Owing to the numerous applications which are being received for power, it has been decided to increase the size of motors let out on hire to 20, 25, 30, 40 and 50 B.H.P.

Tipton.—The U.D.C. has adopted an agreement with the Midland Electric Corporation for the supply of electricity for lighting purposes. The Corporation will pay the Council £600 in respect to the cost of the prov. order, &c., £50 for the ensuing year, £150 per annum for the next two years, and £200 per annum for the remainder of 21 years, with 30s. per week for a meter inspector.

Tonyrefail.—It has been decided to form an electric light company, with £1,000 capital, which will undertake the work of public lighting, and also supply private consumers.

Trowbridge.—An extension of time in which to carry out the prov. order for E.L. has been applied for by the U.D.C.

The Western Electricity Distribution Co. has notified the U.D.C. of its intention to apply for a prov. order to supply electricity for private and public purposes within the Council's area.

Wallasey.—We are informed by the electrical engineer to the U.D.C., Mr. J. A. Crowther, that instead of increasing the charges, as stated in our last issue, the charge for energy will be *reduced* from 6d. to 5d. per unit, with a reduction of 2d. for all supply above two units per quarter for each 8-C.P. lamp, &c.

Wanstead.—The Empire Electrical Co. has informed the U.D.C. of its intention to apply for a prov. order for electric lighting.

Watford.—Owing to the continued demand for electricity, the U.D.C. has instructed the electrical engineer to prepare a detailed report as to the requisite extensions of the plant at the E.L. works.

Westbury.—The U.D.C., after considering the offer of a private company to instal the electric light in the town, has decided that the Council is not desirous of having electricity.

Weymouth.—The U.D.C. has received notice that the Inland Waterways Co., Ltd., intends applying in the next session of Parliament for a prov. order for supplying electricity in the district.

Worcester.—The electricity mains are to be extended to the works of Messrs. Heenan & Froude, at a cost of £1,400, who will be supplied with energy for power purposes at the following prices:—100,000 units to 200,000 units per annum, 1½d. per unit; 200,000 to 300,000, 1¼d.; 300,000 and over, 1d., for at least three years. For the first year there is to be a minimum consumption of 200,000 units, and for each of the other two years 300,000 units.

ELECTRIC TRACTION NOTES.

Aberdeen.—The Tramway Committee has approved of the plans for a car depôt to be erected in Crown Street beside the electricity station to accommodate 12 cars. The estimated cost of the depôt and repairing shed was £4,800, and of the workshop and stores, which the electrical department proposed to erect, £4,200.

Birmingham.—The Council has decided to give notice to the City of Birmingham Tramways Co. to sell to the Corporation so much of the tramways as is within the city. The first line to come within this new phase is the Balsall Heath route, the other routes being on a 21 year's lease, which expires in 1906. Alderman Beale stated that he had told Mr. Garcke that he only expected the company to pay interest and sinking fund, so that the city would not lose. He also hoped the company would not obstruct the Corporation in the electrification of the other steam lines. The Council also granted the request of the Aston Manor Council for the assignment of the lease of the Aston route within the city to the British Electric Traction Co. on its expiration at December 31st next. He held out the hope that all the local authorities interested would work together in order to get the electrification carried out within the next two years. The Council also remitted to the Tramways Committee, with powers to appoint a manager to look after the interests of the Corporation in the matter. It was pointed out that the salary would depend a good deal on the man they were able to get.

Bromley.—A L.G.B. inquiry will be held on the 17th inst. with regard to an application by the B.E.T. Co. to the Light Railway Commissioners for an order to enable them to construct a light railway from Bromley Hill to Green Street Green. The Bromley District Council has decided to oppose.

Burnley.—On Sunday a satisfactory trial trip was made over the Accrington Road section of the Corporation tramways. The L.G.B. inspection was to take place yesterday.

Cardiff.—Messrs. Dick, Kerr & Co. are to be asked to make a car body for a single-deck combination car to the specification of Mr. Arthur Ellis.

Ilkeston.—Mr. Pilcher has been instructed to draw up the necessary plans and specifications for substituting double track in place of existing single track.

London.—As an example of the popularity of the London United Electric Tramways system for affording quick and cheap transit into the country, especially through the lovely valley of the Thames, it is interesting to know that during the past week considerably over a million passengers have been carried, the receipts being £7,654.

BERMONDSEY.—On Tuesday the B.C. received notice from the L.C.C. of intention to electrify the London, Deptford and Greenwich tramways on the underground conduit system. It was resolved to petition against the Supply of Electricity Bill unless Clauses 3 and 6 were deleted.

St. Helens.—From a statement made by Alderman J. Massey, at the monthly meeting of the St. Helens Town Council, on Friday last, it appears that a workable arrangement has been arrived at between the Town Council and the South Lancashire Tramways Co. The negotiations have gone on between the Council and the tramways company since 1900, and have involved references to the House of Lords and the House of Commons as to what constituted reasonable rights, obligations, and privileges of the respective parties. The company sought running powers over the streets and lines owned by the Council, and also powers for goods traffic, but the House of Lords vetoed the goods traffic, on the ground that the streets were not suitable for such. Under the arrangement which was finally come to, running powers over the lines of the Council have been granted to the company. Electricity is to be supplied by the Council for working the tramways within their area. The Council have the power to alter the route and also the times of running, and to construct alternative lines of tramways if they think fit. There are, however, only to be 25 of the company's cars running on the St. Helens tramways at one time. This will mean that the company will be providing a ten-minutes' service throughout the borough of St. Helens. Under these arrangements, it is said, a substantial gain will accrue to the Council.

S. Wales.—It is understood that the Barry Railway Co. have acquired the smelting works at Sully Moors, near the Barry Docks, for the purposes of an electric power station.

(*Continued on page* 63.)

THE RAND CENTRAL ELECTRIC WORKS.

In view of the enormous part that electricity will play in the development of the mining, agricultural and general industries of British South Africa, a short description of the largest central power station now at work in these Colonies should prove of considerable interest.

The great difficulties which have been overcome in the way of transport, water supply, and last, but by no means the least, protection against the frequent and severe lightning storms, which are the dread of South African electricians, speak well for the energy and enterprise of the concessionnaires, Messrs. Siemens & Halske.

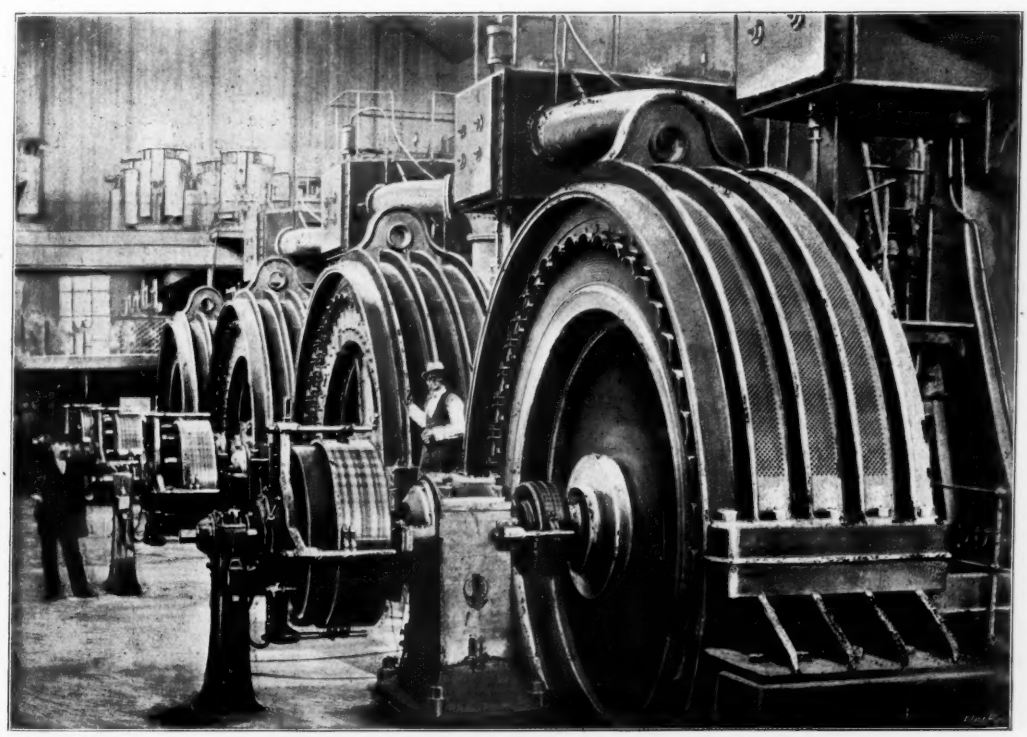
Exterior of Rand Central Electric Works and Residential Quarters.

Transmission Line, and Telegraph Line, crossing on the Veldt.

The scheme for a large central power station, to supply electrical energy to the mines and townships on the Rand, originated with the South African firm of Messrs. J. Hubert Davies & Spain, who obtained a concession from the then South African Republic to carry out their scheme. In the concession was also contained a clause by which they had the right to carry lines over proclaimed goldfields without further fee than that paid to the Government.

In 1895 the concession was made over to Messrs. Siemens and Halske, who proceeded to carry out the project on behalf of the Rand Central Electric Works, Ltd., a company which was then formed, Messrs. Siemens & Halske, as the concessionnaires, guaranteeing the dividends.

They selected for the site of the works a spot about a mile from Brakpan, in the East Rand, and about 22 miles from Johannesburg. The site was well chosen, at once reducing to a minimum two of the greatest difficulties of the country, as the works were built on the borders of a large dam, having a capacity of 28½ million gallons, and within sight of several large collieries. Building operations were commenced in 1895, and the beginning of 1897 saw the inauguration of the works, when the supply of electrical energy was commenced with a load of 300 kw.



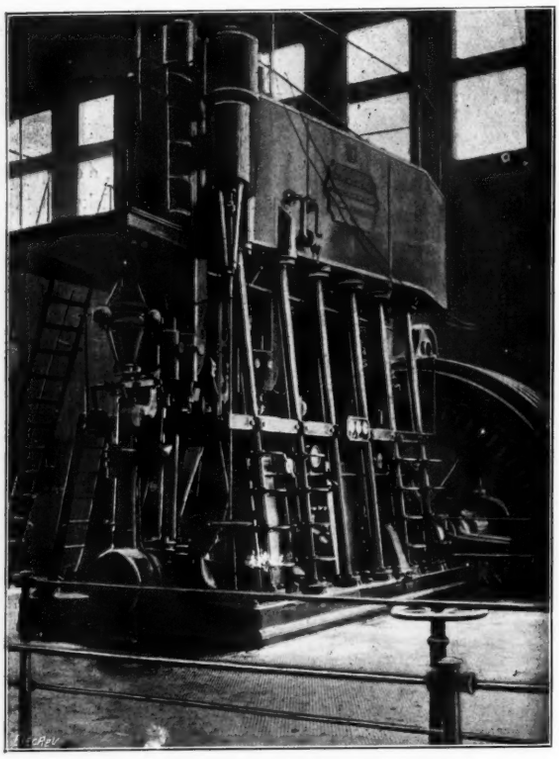
General View of Generating Plant.

The works were, of course, built to the designs of and carried out by Messrs. Siemens & Halske, who controlled the works on behalf of the Rand Central Electric Works, Ltd., until the expiration of the concession in 1900; at that date the big German financial house, Messrs. A. Goerz and Co., Ltd., acquired a large interest in the undertaking, and it is now practically controlled by them.

A private siding from the main railway line was built to carry the plant, &c., to the works, and is now used to convey coal from the colliery of the Transvaal Coal Trust Co., Ltd.

Going towards the works from Brakpan Station, all that is visible until one is quite close is the two tall chimney stacks, which, by-the-way, were made a target of by the British artillerymen from a neighbouring dump-heap during the war, in mistake for Boer Long Toms, the station being built in a hollow.

Up to the present no additions to the initial plant have been made, although many minor alterations and extensions, principally in the line, have taken place; but large ex-



800-kw. Generating Set, showing Engine.

tensions to the plant are now under consideration, which will add about 1,600 kw. to the capacity of the station, and will probably consist of turbo-generators.

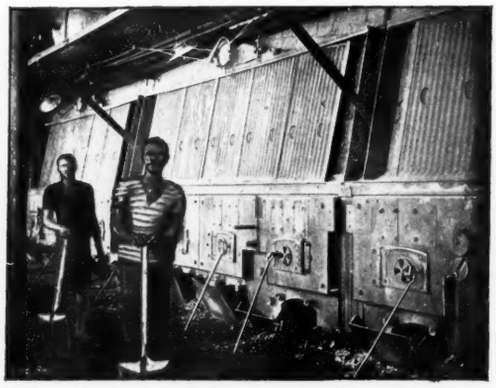
The works proper consists of a large engine room, containing generating plant, auxiliaries, switchboard and transformer platforms, boiler house with coal shed, mechanics' shop and electrician's laboratory, all roomy, well lighted, and very conveniently arranged.

The generating plant consists of four 1,000-h.p. triple-expansion condensing engines, by Richard Hartman, of Chemnitz, direct coupled to four 800-kw. three-phase alternators, generating electricity at a pressure of 800 volts, with a frequency of 50 cycles per second.

The engines, running at a speed of 100 r.p.m., have done good service, and are frequently called upon to develop 1,200 h.p. The steam pressure is 175 lbs. per sq. in., and an average vacuum of 25 in. being obtained, the steam consumption generally runs no higher than 15·4 lbs. per h.p.-hour.

The valves of the high pressure cylinder are of the piston type, whilst those of the intermediate and low pressure cylinders are ordinary flat slide-valves. Regulation is performed by means of a special motor-driven governor, controlled from the switchboard.

The generators are of Messrs. Siemens & Halske's stationary armature type, wound on the star system; the rotating fields are excited from dynamos carried on the end



Boilers as now arranged for Hand Firing.

of the main shafts. The exciters are of the internal field type, with external commutator, and supply current at a pressure of 120 volts.

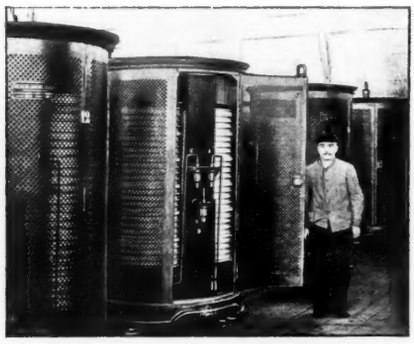
Regulation is effected by means of field and main current rheostats, which also are operated by a small motor controlled from the switchboard, the electrician-in-charge thus having complete and instant control over both the excitation and the governing of the generators, an admirable arrangement.

The engine room equipment also includes a small auxiliary generating plant for lighting the works during emergencies.

The condensing plant is in duplicate, each set providing for two generators, and consisting of a 100-h.p. compound engine on the main floor, driving direct an air pump, and by belt, a centrifugal circulating pump in the basement. Circulating water is obtained from the dam outside.

Make-up feed water for the boilers is drawn from a well 80 ft. deep, on the further side of the dam, by means of a small motor pump; the condenser water, after being filtered, is pumped back to the boilers, the high temperature obviating the use of heaters.

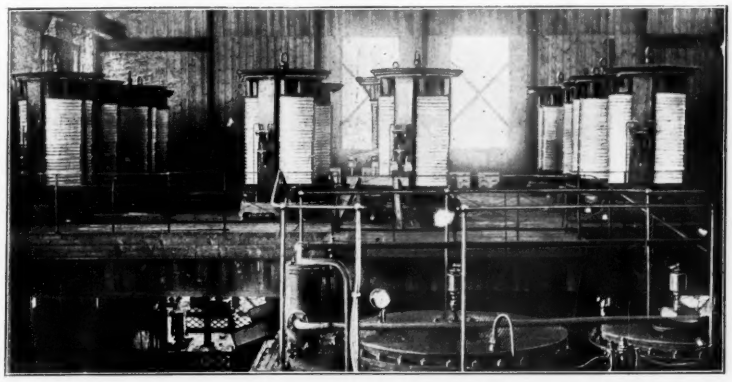
The boiler house, running parallel with the engine room, contains eight Steinmüller multi-tubular boilers, each having a capacity of 500 h.p. and a heating surface of 3,300 sq. ft., and generating steam at a pressure of 180 lbs. per sq. in. Stoking was formerly done mechanically, but the nature of the fuel proving unsuitable, it is now performed by hand.



Transformers in Sub-Station.

Coal is derived from the colliery of the Transvaal Coal Trust Co., about ¾ mile away, and is conveyed along the private line direct into a coal shed forming an extension of the boiler house; from this it is carried in trucks to the boilers. The ash is simply disposed of, being used to form and strengthen the breakwater of the dam.

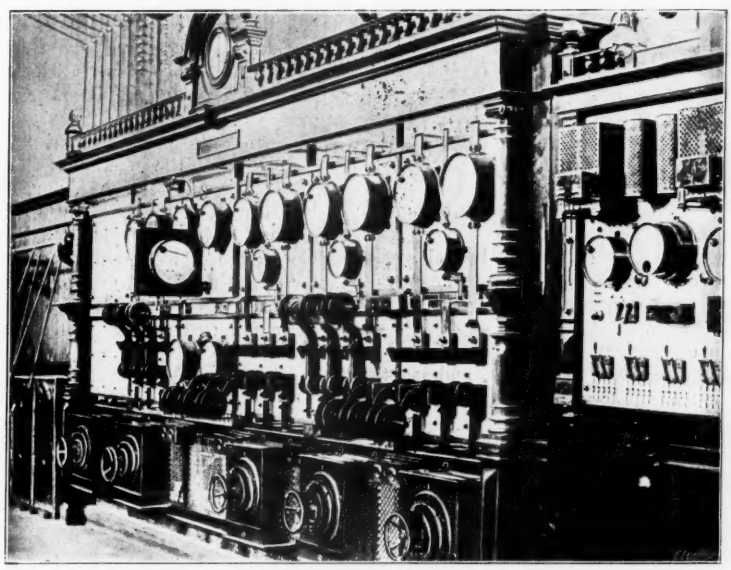
The average amount of coal used is 4,000 tons per month.



Transformer Gallery in Engine Room.

The switchboard is fixed in a recess off the centre of the engine room, from which a full view of the generating plant is obtained, and contains 1,000-ampere main switches; Ferraris watt-hour, ampere and voltmeters; also synchronisers, exciter, and governor regulator switches.

Current enters the board from the generators at 800 volts, and from the bus-bars passes to the transformer platforms, which are erected at the further end of the engine room, and are open and in full sight. Here are installed 16 200-kw. three-phase transformers, which raise the pressure from 800 to 12,000 volts.



Main Switchboard.

In an intermediate platform or chamber, on the low pressure side, are placed both switches and fuses, but on the high pressure side, fuses alone, the line being intersected with air-break switches along the route.

The transformer coils are built in sections, spare ones always being at hand, so that a breakdown can be quickly rectified. The secondary pressure varies from 10,000 to 12,000 volts, according to the load.

The rest of the works equipment consists of smith's shop, mechanics' tool room and electricians' laboratory, where the repair of motors and transformers, and the calibration and repair of meters are undertaken.

The Aron meters were formerly used, but have been found unsuitable for this country, where the dust storms play havoc with the mechanism, and they are now being gradually replaced with Ferraris watt-hour meters.

The out-houses consist of stores, stables, Kaffirs' compound, and further away, the residential quarters of the white staff. The staff aggregates some 160 men, of whom 130 are Kaffirs employed in stoking, greasing and general labouring.

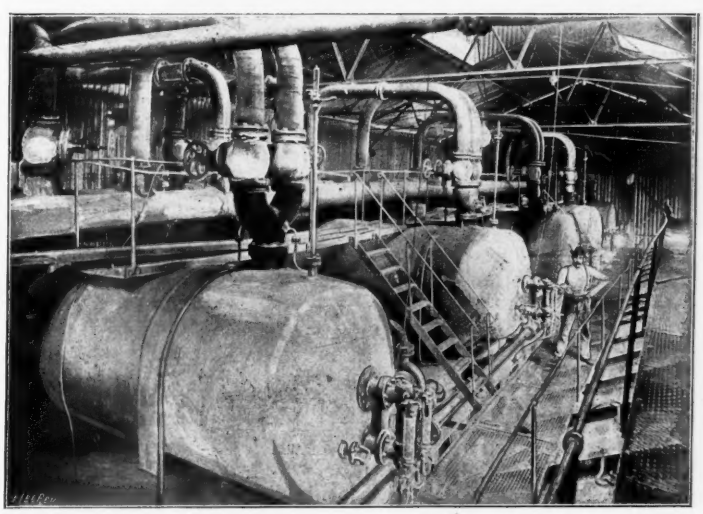
The white staff consists of a general manager, resident engineer, storekeeper and compound manager; also two electricians, three switchmen, five enginemen, four greasers and four fitters, a boilermaker, mason, carpenter and plumber. Employment is also found for three apprentices.

For the upkeep of about 28 miles of line, three inspectors and three linesmen have been found ample; these, however, are tried and competent men, and hold positions of trust and responsibility.

The line, as intimated, consists of 28 miles of conductors, running along the veldt to Johannesburg, and branching off to the various mines supplied on the way.

The cables are three double bare wires of a sectional area of 140 sq. mm. per double wire, supported by steel poles 28 ft. high, made by the British Mannesman Tube Co., the distance between poles being 90 ft. The line is wire-guarded the whole of the route, and to overcome self-induction and atmospheric effects, the insulators are so arranged as to give a continual helical twist to the line, the original position of the insulators recurring at every sixth pole.

Great trouble was at first experienced from lightning, but, by continual and persevering experiments, a form of horn arrester has been devised which has practically overcome this difficulty.



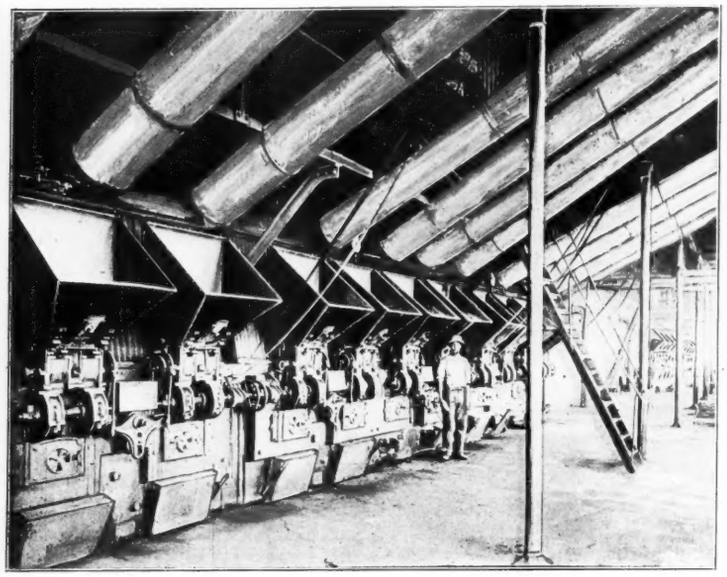
Top of Boilers.

The line is divided into sections, connected through with air-break switches fixed high up on the poles. Telephone boxes are also installed at these points to facilitate the repair of faults. Faults on the line rarely occur between Brakpan and Elandsfontein, but at this station branch lines become frequent and the insulation difficult to maintain.

A high line efficiency is obtained; the loss by leakage, in resistance, and in transformers has been found to be only 7 per cent. from Brakpan to Johannesburg during the time of the maximum load.

Where the line has to cross the main road, according to regulations this must be done at right angles, and it is estimated that the strain on the poles at these points exceeds 4 tons.

Each mine supplied is equipped with a separate transformer station, where the pressure is reduced to 120 volts for lighting and 250 or 500 for power purposes. Access to these stations is only gained by the Brakpan linesmen, the responsibility of the company ceasing at the low pressure bus-bars, which are contained in a separate compartment.



Boiler House, as Originally Arranged.

Berea Sub-station, Johannesburg.

The largest consumer is the Johannesburg Municipality, which obtains 800 KW. at a pressure of 2,000 volts from a transformer station in Berea Street, Johannesburg. The station is divided into two compartments, one of which contains the company's step-down transformers, regulators, &c., and the other the 2,000-volt bus-bars, switches, instruments, &c., in charge of an attendant of the municipality.

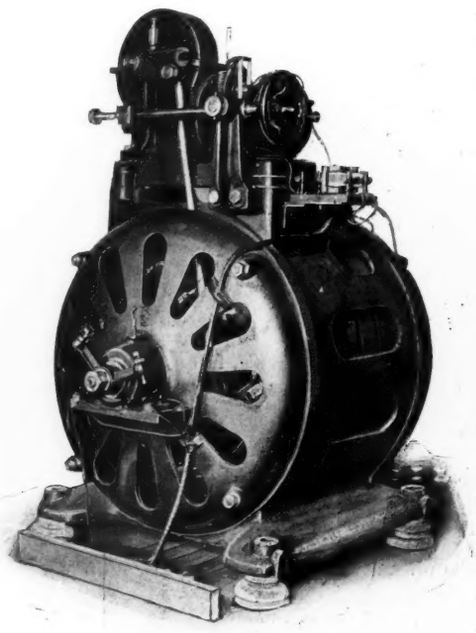
Current at 10,000 to 12,000 volts pressure enters the transformer station through a double-prong air-break switch erected at one end of the chamber and close to a door opening from the outside, access to the switch being gained from that door only.

The secondary pressure of the transformers is regulated, as will be explained later, automatically; under ordinary circumstances there is absolutely no need to enter the high-pressure chamber after the current is switched on, which is generally about 5 p.m.

Installed in the transformer chamber are eight 100-KW. three-phase transformers, five of which installed at the commencement are air-cooled, the rest being of a new oil-insulated type, recently put down. They are arranged along the sides of the chamber, with all the high-pressure coils facing the centre of the room. The current passes from the high-pressure switch through copper bars, all painted red, to the fuses arranged on frame work close to the floor, and thence to the transformers, all the primary wires thus being kept distinct. The secondary, or rather the 2,000-volt wires, are taken upwards to porcelain insulators arranged on beams, and thence through to the other chamber and the bus-bars belonging to the municipality.

The contract between the Johannesburg Municipality and the R.C.E.W. stipulates that the secondary pressure shall be kept within $2\frac{1}{2}$ per cent. of 2,000 volts. To comply with this regulation there are installed in the high pressure chamber two regulators or equalisers. One, installed since the commencement, is a transformer-type regulator. Connections made from the junction of the star winding to the coils of the regulator, are arranged to add to, or deduct from, the bus-bar pressure to an extent of 250 volts, according to whether the pressure is low or high.

The regulator is worked automatically by a small electro-motor operating a cam and plunger arrangement. On the plunger is a spring catch, corresponding with notches on the circumference of the switch wheel, an electro-magnet bringing these into contact. The magnet is in turn worked automatically direct from the bus-bars, through a small step-down transformer, and a relay instrument of Ferraris manufacture. When the pressure is high it operates the relay, closing the electro-magnet circuit, and thus bringing the plunger into contact with the switch.



Automatic Pressure Regulator, New Type.

The other type, recently installed, is, as will be gathered from the view on the opposite page, in the shape of an induction motor, the small motor in this case being placed on the top; this, through worm-gearing, operates a crank turning the rotor, which moves through two right angles. This alters the pressure of the circuit, by raising or lowering the power factor of the transformers.

The small motor of this regulator is operated similarly to the other, but has a distinct advantage, as in this case the motor runs only when required.

The pressure here, after being transformed down to 2,000 volts, is further reduced by the municipality in transformer kiosks in the streets, and on the consumers' premises, to 120 volts.

Current from this transformer station is used to light Jeppestown, Doornfontein, Hospital Hill, Yeoville and Berea, suburbs of Johannesburg. Mention must also be made of a large store erected on the City and Suburban G.M. Co.'s property, where motors, transformers, and all electrical accessories are kept to supply mines, &c., on the Johannesburg side of Elandsfontein.

Two regulators are installed in the transformer stations supplying the Johannesburg railway station and the Elandsfontein railway station. These stations absorb loads of 150 and 50 KW. respectively.

The highest maximum load of the Brakpan works is 2,200 KW., and the average maximum load 1,600 KW., the various mines along the route, amongst which may be mentioned the following, absorbing the rest:—Coal mines at Brakpan, Witwatersrand Deep G.M. Co., May Consolidated G.M. Co., Jumpers Deep G.M. Co., Jumpers G.M. Co., where a large underground electric hoist is installed, &c.

The cost of generation is about 1·5d. per unit, and energy is supplied to consumers at various charges, arranged to be advantageous to both consumer and supplier.

Our grateful acknowledgments are due to Mr. J. C. F. Bergsma, the acting general manager, and Mr. W. Mauss, the resident engineer at Brakpan, especially to the former, who made a special appointment with our representative to go out to Brakpan from Johannesburg, and gave much valuable assistance in the preparation of this article.

ELECTRIC TRACTION NOTES.

(*Continued from page* 58.)

Middlesex.—At the County Council monthly meeting on Thursday of last week, it was reported that the tramway agreement with the Metropolitan Electric Tramways, Ltd., had been practically settled in accordance with the terms of the Council's resolutions of April 30th last. It would, however, be necessary to have a separate agreement with the North Metropolitan Electric Power Supply Co. as a security for the carrying out of the agreement with the first-mentioned company. A further report presented showed that the County of Middlesex Light Railways Order, 1903, authorising the construction of light railways in the parishes of Acton, Edgeware, Edmonton, Enfield, Finchley, Friern Barnet, Hendon, Hornsey, Little Stanmore, Southgate, Tottenham, Wembley, Willesden and Wood Green, had been submitted to the Board of Trade for confirmation, and would probably be confirmed in due course. The following estimates had been submitted to the County Council by the Finance Committee:—County of Middlesex Light Railways (Enfield extensions), £74,862; light railway from Whitstone to the county boundary, £10,725; County of Middlesex Light Railways, 1902, Order No. 1, £779,312. The Council now requested the Finance Committee to submit a further estimate of £135,000, which, added to the £864,900 already submitted, would make up the £1,000,000 authorised to be borrowed under the Order.

Reading.—The Town Council purpose opening the new electrical tramways on the 22nd inst.

Wolverhampton.—Within the past few days a balance-sheet, showing the result of the working of the tramways during the past 12 months, has been prepared by the borough accountant (Mr. Howell), but it has not yet been officially published. However, Mr. Alderman Craddock (deputy chairman of the Tramways Committee) at a municipal election meeting at the close of last week, stated that he had no right to make the contents of the balance-sheet public, but he said the tram question was being so misrepresented that it was time someone laid the real facts before the ratepayers. He had seen a statement in the *Express and Star* that the old horse cars used to make a profit, but their up-to-date electric cars were running at a loss. The statement he held in his hand was not his (Alderman Craddock's) but the borough accountant's, and though he was not infallible the figures could not lie. During the past year the figures were—

HORSE TRACTION.

Expenditure	£5,478	15 1
Income	4,654	14 0
Loss on the working ...	£824	1 1

No allowance was made in these figures for interest or sinking fund they were the working costs only.

ELECTRIC TRACTION.

Expenditure	£11,670	2 10
Income and advertisements	21,352	17 2
Gross profit	£8,682	14 4

They could not depreciate the horse lines, so they charged the interest and sinking fund of both classes against the electric traction. This gave—

Loss on horse traction	£824	1 1
Interest	4,353	5 10
Sinking fund...	2,226	7 6
Reserve fund	1,972	8 1
Loss on the year	£256	13 5

It was a huge blunder, in his opinion, to have continued the horse traction, but they had wiped off the loss, and that was the result after placing £2,000 to reserve, which they need not do. It may be added here that Alderman Craddock has omitted from his statement the sum of £436 14s. 9d. bank interest, which will make his figures agree. Since then Alderman Lewis, a member of the Tramways Committee, has also been speaking at a municipal election meeting, and replied to Alderman Craddock. He (Alderman Lewis) asserted that the tramways undertaking was at present in debt to between £2,000 and £3,000; and further, if everything else was counted, the total indebtedness would amount to something like £4,000 or £5,000. He was, he said, prepared to prove that Alderman Craddock's speech did not contain an exhaustive statement of the financial condition of the tramways. His figures in many respects were inaccurate, and in other respects they were altogether illusive. Alderman Craddock had not said a word about depreciation and maintenance of the tram system for the year, which would mean nearly £2,000, nor about the fact that in the balance-sheet they had omitted to put down anything at all for the rent of the land on which the car-shed stood. As to £50 being paid for insurance *re* third parties, a little time ago a cheque for £250 was passed, and if the Corporation had their third party risks properly insured £500 ought to have been put down in the balance-sheet. A complete balance-sheet was asked for long ago. It could have been, ought to have been, and would have been laid before the town if there had been anything like business capacity in the chair of the committee. Months ago he (Alderman Lewis) prophesied that there would be a deficit respecting the trams. When he said so, Alderman Craddock declared there would be a profit on the trams satisfactory to the ratepayers. Now, on his own admission, there was a loss of about £250. Proceeding, Alderman Lewis contended that the Act of Parliament under which the town had a right to run the trams said that if there was a loss upon them it must be met "forthwith" by the raising of the rate. If there was no juggling with figures, and if some ingenious subterfuge were not adopted for the hanging up of the debt incurred, the tramways would mean 2d. on the rates next year.

TELEGRAPH AND TELEPHONE NOTES.

American Pacific Cable.—The last connection of the Commercial Pacific cable was made at Honolulu on Saturday night last, and President Roosevelt sent a message of greeting to General Taft at Manila. Later, the President (at 11.25 p.m.) sent a message westward round the world to Mr. Clarence H. Mackay, President of the Commercial Pacific Co., who was with Mr. Roosevelt at Oyster Bay. The message came back at 11.35 p.m. Mr. Mackay's reply to Mr. Roosevelt, which was sent eastwards around the globe, returned in 9½ minutes.

Brighton Telephones.—The National Telephone Co. have decided to impose terminal fees on calls originated by Corporation subscribers at the maximum in the scale mentioned in the Corporation license, and the Corporation propose to charge terminal fees to the same extent that the National Telephone Co. charge them.

East Dereham Telephones.—The U.D.C. has appointed a Committee to consider the provision of a telephone system for the town.

New French Cables.—In the Chamber of Deputies on June 29th, the Bill for the laying of cables between Brest and Dakar, between Madagascar, Reunion and Mauritius, and between Saigon, Pulo-Condor and Pontianak, was adopted, after urgency had been declared for the measure.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Martinique-Puerto Plata	July 10, 1902	
Cayenne-Pinheiro	Aug. 18, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa	Oct. 22, 1902	
Reissa-Yemani	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 13, 1903	
Siteebondo-Bandlermasin	July 6, 1903	
Landlines.		
Dagua-Buenaventura	June 22, 1903	June 25

Wireless Telegraphy.—In the House of Commons on June 30th Mr. Bonar Law told Major Seeley that it was proposed in the first instance to connect with shore stations by wireless telegraphy the following six lightships:—The East Goodwin, the South Goodwin, the Gull, the Tongue, the Sunk, and the Cross Sand.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdare.—July 11th. The U.D.C. wants tenders for the installation of fire call bells. Particulars at the Surveyor's Office, Town Hall.

Bath.—July 17th. Jet condensing plant, feed pump, pipe work, &c., for electricity supply extensions. See "Official Notices" July 3rd.

Blackburn.—July 27th. Main switchboard and accessories. See "Official Notices" to-day.

Colne.—July 21st. Lancashire boiler, stoker, cable, condenser, &c. See "Official Notices" to-day.

Derby.—July 13th. Battery, balancers and boosters, switchboards. See "Official Notices" July 3rd.

Guadeloupe.—August 29th. Tenders are being invited until August 29th next by the municipal authorities of Point à Pitre (Guadeloupe) for the concession for the public and private electric lighting of the town.

Hammersmith.—July 15th. Forty alternating current arc lamps, &c. See "Official Notices" June 26th.

Hammersmith.—July 21st. Electric pumping plant for the Borough Council. See "Official Notices" to-day.

Hungary.—August 31st. Tenders are being invited until August 31st next by the municipal authorities of Beszterczebanya (Neusohl) for the establishment in the town of a central electricity generating station of a capacity of 500 H.P.

Ipswich.—July 14th. Electricity meters. See "Official Notices" June 26th.

Launceston (Tasmania).—September 28th. 500 or more electric meters. See "Official Notices" June 12th.

London.—August 11th. Low tension feeder switchboards for the tramways sub-stations in Camberwell and New Cross. See "Official Notices" to-day.

New South Wales.—September 12th. Tenders are being invited by the Railway Commissioners for New South Wales, for an additional generating set of 1,500 KW. for their tramway power station.

Newport (Mon.).—July 16th. The School Board are prepared to receive tenders for the installation of the electric light at S. Woolos Schools. Tenders to, and details from, John Hutchin, clerk to the Board.

Pietermaritzburg.—July 29th. Six each single-deck bogie and double-deck single-truck cars for the Corporation. See "Official Notices" July 3rd.

Poplar.—July 22nd. Water softening plant for the workhouse. See "Official Notices" to-day.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Preston.—July 22nd. Boiler house plant for tramways power station (economisers, feed heaters, and pumps). See "Official Notices" to-day.

St. Asaph.—July 16th. Electric lighting of the workhouse and new infirmary. Details from the Master of the workhouse.

St. Pancras.—July 14th. 350,000 carbons (12 months' supply). See Official Notices" June 19th.

St. Pancras.—July 14th. Electric jenny and crab. See "Official Notices" June 26th.

Servia.—July 13th. The municipal authorities of Nisch are inviting tenders until July 13th for the establishment of a central electric lighting station in the town.

Sheffield.—July 21st. Electricity meters. See "Official Notices" to-day.

Spain.—July 25th. Tenders are being invited by the Spanish Post and Telegraph Authorities for the supply of 4 tons of bronze wire 2 mm. diameter, and 8 tons of copper wire 3 mm. diameter. Tenders are to be sent to La Direccion General de Correos y Telegrafos Carretas, 10, Madrid, whence particulars may be obtained.

Stepney.—July 21st. Pipe work, water softening plant, and storage tanks, for the electricity works. See "Official Notices" June 26th.

Swindon.—July 23rd. Seven electric cars with trucks and motor equipments. See "Official Notices" to-day.

Tiverton.—July 18th. Electric lighting installation for the borough. See "Official Notices" to-day.

West Ham.—July 14th. High-tension feeders and other cables. See "Official Notices" June 19th.

Weymouth and Melcombe Regis.—July 19th. Boilers, engines and dynamos, and various other plant for electric lighting. See "Official Notices" June 26th.

CLOSED.

Battersea.—The B.C. has accepted the tender of the General Electric Co. (1900), Ltd., for switches, &c., at £167, and for lamps at £83. Also the tender of the Walsall Electrical Co., Ltd., for fuse boxes at £227. An order for flexible wire has been placed with Messrs. W. T. Glover, Ltd.

Bermondsey.—The B.C. received the following tenders on Tuesday, for a reversible booster:—Crompton & Co., Ltd. (accepted), £449; Lancashire Dynamo and Motor Co., Ltd., £388; Electric Construction Co., Ltd., No. 1 tender £612, No. 2 £685. The Albion Clay Co. was the successful tenderer for 9,000 yards of 4-in. conduits at the following prices:—2-way, 2s. 9½d. per yard; 3-way, 3s. 10d.; 4-way, 4s. 10d.; 6-way, 7s. 8d.

Colchester.—The T.C. on July 1st accepted the following tenders:—Henley's Telegraph Works Co., Ltd., for cable, at £1,635; Klein Engineering Co., for water-cooler and tray, at £713; Messrs. Davey, Paxman & Co., for condenser pipe work, at £116, and exhaust range, at £225.

Felixstowe.—The U.D.C. has accepted the tender of Messrs. Johnson & Phillips for the supply of arc lamps and for cables, the latter at £945.

Gloucester.—A joint meeting of the Electricity and Tramways Committees of the City Council was held on Friday last week to consider tenders received in connection with the Corporation's tramways undertaking. The report of the consulting engineers was received, and the tender recommended to the Council for acceptance for the power station (excluding the enlargement of buildings) was £7,042 16s. The tender decided upon for the whole of the outside work, as distinct from the generating station, was £69,104 7s. 7d., and does not include the enlargement of the car-shed in Bristol Road.

Islington.—On Friday of last week second revised tenders were received by the Borough Council for the extension of mains in the Canonbury district. The tenders, original and revised, were as follows:—Anchor Cable Co., Ltd., original tender, £5,161, first revised tender, £6,117, second revised tender, £5,710; Western Electric Co., original tender, £5,197, first revised tender, £5,373, second revised tender, £5,408; W. T. Glover & Co., Ltd., original tender, £5,531, first revised tender, £5,615, second revised tender, £5,650; British Insulated & Helsby Cables, Ltd., original tender, £6,143, second revised tender, £5,351; St. Helens Cable Co., Ltd., original tender, £6,145, second revised tender, £6,151; Callender's Cable Construction Co., Ltd., original tender, £6,435, second revised tender, £6,272; Siemens Bros. & Co., Ltd., original tender, £6,539, second revised tender, £6,205; Henley's Telegraph Works Co., Ltd., original tender, £6,556, second revised tender, £5,273; W. F. Dennis & Co., original tender (No. 1), £7,013, original tender (No. 2), £7,177, second revised tender, £6,315. The second revised tender of the British Insulated and Helsby Cables, Ltd., at £5,351 was accepted, and a motion for the sealing of the contract was passed. The Electric Lighting Committee again brought up a recommendation (referred back by the Council at the last meeting) that a contract be sealed with the Electrical Construction Co., Ltd., for the supply of 37 30-KW. transformers for £2,966 10s. 6d. After discussion the recommendation was agreed to.

Leith.—The Scottish Co-operative Wholesale Society, Ltd., has placed an order for one 100-KW. engine, and a Mather and Platt generator for its Leith branch, with Messrs James Howden and Co., Glasgow. For the Rishton Paper Mills, of Messrs. A. M. Peebles & Son, Ltd., Messrs. Mather & Platt, Ltd., have placed an order for one compound engine of 300-H.P. in connection with the electrical equipment, with Messrs. J. Howden & Co.

London.—The L.C.C. has accepted the tender of Kirk and Randall, amounting to £29,434, for the erection of the second portion of the Clapham car-shed.

Rochdale.—The following tenders have been accepted by the T.C. for the tramways:—Messrs. J. G. White & Co., Ltd., for overhead line equipment, at £21,620; Lorain Steel Co., for

points and crossings for special work, entrance to car-shed, rails, and fishplates, at £2,587; Hadfield's Steel Foundry Co., Ltd., for points and crossings for the general track, at £5,322.

Stepney.—The Lighting Committee of Stepney Borough Council has received the following tenders:—For supplying carbons for the year ending June 30th, 1904, Messrs. Johnson & Phillips (recommended), £264; G. Braulik, £266; Crompton & Co., Ltd., £266; Sloan Electrical Co., Ltd., £266; General Electric Co., Ltd., £289. For supplying meters for 12 months—up to 10 amperes, Reason Manufacturing Co., Ltd. (recommended), £331; Ferranti, Ltd., £337 10s; Chamberlain & Hookham, Ltd., £400. Above 10 amperes, Messrs. Ferranti, Ltd. (recommended), £534; Chamberlain & Hookham, Ltd., £635; Reason Manufacturing Co., Ltd., £680. For supplying demand indicators for the year—Reason Manufacturing Co. (recommended), £615; General Electric Co. (1900), Ltd., £660. Eight tenders for meters and four for demand indicators were rejected as not complying with the specifications.

FORTHCOMING EVENTS.

Monday, July 13th.—At 5 p.m. Physical Society. Special general meeting of the Fellows at the Royal College of Science, South Kensington, to pass a special resolution relating to the articles of association.

Wednesday, July 15th, and three following days.—Convention of the Municipal Electrical Association at Sunderland, &c.

ADDENDUM TO ELECTRIC TRAMWAYS LIST.

Salford.—Miles of track, 53, mostly double. Annual car-mileage, 3,380,590; pass. carried, 28,150,675. Cost per car-mile, 7·44d.; ratio of expenses to receipts, 72·47%. Energy purchased from Electricity Committee at 2d. per unit.

NOTES.

Grimsby's Refuse Destructor.—After many years of consideration, during which the members of the Works Committee have visited many towns to inspect various types of refuse destructors, the Borough of Grimsby is at last in a position to deal with the town's refuse in a sanitary and scientific manner. A four-cell Horsfall destructor has been erected, capable of dealing with 40 tons of refuse per day, at a total cost of about £10,000. This figure includes the crusher and mortar mill and offices. The drying fires were lighted on April 20th, and the destruction of refuse began on May 11th. The furnaces are of the Horsfall standard type, with top feed. A clinker conveyer is fixed in front of the furnaces, by means of which the clinker is conveyed to the crusher house, where crushers and mortar-making machinery are fixed. A Babcock-Wilcox boiler is fixed in conjunction with the destructor, the steam from which will drive the motor-making machinery, and if there is any surplus it will, no doubt, be used in the adjoining electricity works. A centrifugal dust-catcher, a speciality of the Horsfall Co., is fixed near the chimney, and space is left for an economiser and a second boiler, which will be fixed when the electricity works requires extensions. We wish success to the venture, and are glad to find that no absurd claims are put forward as to steam-raising.

Obituary.—The death took place on Sunday last of Mr. G. H. Robertson, who will be remembered by many of our readers for his work on the "Chemistry of Secondary Batteries," the main results of which were embodied in papers read before the Royal Society in June, 1891. Mr. Robertson, who was the son of a distinguished Indian officer, began life in the Army, but was compelled to resign his commission after a few years on account of ill health. He then (1885) took up electrical engineering and electro-chemistry, and studied under the late Mr. W. Lant Carpenter and Profs. Ayrton and Armstrong. In the spring of 1892 he was elected registrar and secretary of the Institute of Chemistry, but in 1894 illness brought on blindness, and once again an active career had to be given up. There was a strong vein of originality in Mr. Robertson, and had he only been given the ordinary allowance of physical well-being, he would undoubtedly have made further valuable additions to our electro-chemical knowledge.

Our National Trade.—The members of the Committee which has been appointed for the purpose of inquiring into the position and duties of the various Government departments, with the view of consolidating the commercial and trade interests of the country in one department, are:—Lord Jersey (chairman), Sir J. Gorst, Sir J. Mackay, Sir C. Ryan. There is to be one other member, and his name will be announced shortly.

Personal.—Mr. David Martin, late assistant and interim works manager of Messrs. Ferranti's switch department, has been appointed manager of the Electrical Trades Supply, Ltd., Birmingham. Before leaving he was made the recipient of many useful presents and congratulatory wishes.

The Chester and North Wales District staff of the National Telephone Co. have presented a carved polished oak spirit frame, mounted with electro-silver, and three etchings of old Chester, to Mr. Lowe, late manager of the district, on his departure for London. Mr. Lowe is succeeded at Chester by Mr. Stirling.

The South-West Lancashire staff of the National Telephone Co. have presented a fitted travelling bag and fitted dressing case to Mr. F. J. Gerrard, chief electrician, on his departure to take up a position with the company in London.

Sir Samuel Canning's address is now Dashwood House, New Broad Street, E.C.

Mr. J. B. Peace, M.A., Emmanuel College, has been appointed Lecturer in Electrical Engineering at Cambridge, for five years from midsummer, 1903.

The staff of the Sheffield Corporation Electric Tramways have presented a case of cutlery to Mr. A. A. Alton on his marriage.

B.E.T. Annual Sports.—On Saturday, July 4th, the B.E.T. annual sports were held for the third year in succession on the club ground at Wormholt Farm, Shepherd's Bush, and some very keenly contested races were witnessed by a large assemblage, who fully appreciated the high standard of athletics which was maintained in the different events. Apart from the general amusement caused by such contests as the sack race, potato race, and three-legged race, great interest was shown in those events which counted in the competition for the very handsome challenge cup presented to the club by Mr. E. Garcke; this was won by Mr. H. A. Stagg, who showed himself a very good all-round athlete, though he was closely pressed by the other competitors in some of his races. The most sporting event was undoubtedly the 100-yards handicap veteran's race, which resulted in one of the closest finishes of the day. An excellent programme of music was performed by the "T" Division Police Band, eight of whom subsequently engaged in a tug-of-war with ten of the B.E.T. staff, who proved victorious, amid loud cheers. The prizes, which were presented by various donors, were then distributed by Mrs. E. Garcke, to whom a hearty vote of thanks was carried by acclamation. After sundry other cheers in honour of various sports officials, the function terminated, and the performers and spectators alike departed after a most enjoyable afternoon.

Physical Society.—The meeting of June 26th (Dr. R. T. Glazebrook, F.R.S., president, in the chair), was held by invitation of Dr. Waller, in the Physiological Laboratory, University of London. Dr. Waller gave a demonstration of "The Effect of Light on Green Leaves." The effect of light is to produce a current (of an E.M.F. of the order of 0·01 volt), at first from the illuminated to the dark parts in the leaf, and later (or as an after effect) from dark to illuminated. These currents are apparently an index of two opposite processes in the leaf, *i.e.*, dissimilation and assimilation, and give very close analogies to the analogous processes in animal tissues (*e.g.*, Nerves). Dr. Waller also demonstrated the "Blaze" currents in animal and vegetable tissues. These are seen when a strong exciting current (such as an induction-shock of sufficient voltage) is led through a pair of non-polarisable electrodes, and these are then connected with a galvanometer. An electrical response (of greater energy than the exciting current) is given in the reverse direction to the ordinary polarisation counter-currents. Dr. Waller also showed two methods for the quantitative estimation of chloroform vapour in air. Dr. N. H. Alcock exhibited a method of determining the temperature limits of nerve activity in warm-blooded and cold-blooded animals.

Correction.—In our report last week of the proceedings in connection with the Sheffield Corporation Bill, for "Mr. Hassett," read "Mr. R. P. Blennerhassett, K.C.," who was counsel for the petitioners, with Mr. M. O'Sullivan as junior.

New Magnetic Observatory.—In regard to the intended removal of the magnetic observatory from Kew Gardens, on account of the instruments being disturbed by electric traction, it is understood that negotiations have been practically concluded with the Duke of Buccleuch for acquiring a piece of ground on the farm of Cassock, in the parish of Eskdalemuir, about fifteen miles above Langholm. It is not intended, it appears, to do the ordinary commercial work connected with the Kew Observatory at Eskdalemuir. The regulation of ship's compasses, &c., will be done in London as usual, but in regard to earth currents and seismographic observations generally they will be made at the new institution. The new site is 15 miles from any railway.

International Fire Prevention Congress.—During the past week the above Congress, convened by the executive of the British Fire Prevention Committee, has been holding its meetings, with headquarters at the Caxton Hall, Westminster. On Monday last the formal opening of the Congress was performed in the Empress Theatre, Earl's Court, by the Rt. Hon. the Lord Mayor of London, and following that during the remainder of the week were sectional meetings, luncheons, receptions and *fêtes, ad lib.* At the sectional meetings papers were read on "Building Construction and Equipment," "Electrical Safeguards and Fire Alarms," "The Storage of Oils, and Spontaneous Combustion," "Fire Survey and Fire Patrols," "Fire Losses and Insurance," and "Fire Tests and Standardisation." Papers of electrical interest were read by Messrs. Alex. Siemens, G. H. Ostway, E. C. de Segundo, Hip. Cazier, and Alfred Hands, a digest of which will appear in our next issue.

Experimental Boiler Testing.—The description of the experimental boiler given to the Ohio University serves to remind one that it is by no means necessary for the purposes of the student that the plant they test should be particularly high class. College professors make the huge mistake of aiming at records. They strive for some record evaporative performance, throw into the face of a gaping world impossible efficiencies and expect figures to be swallowed which trench dangerously on the verge of 100 per cent. Everyone, except a few of their students, knows their figures to be unreliable and strained. The worst of it is that a false standard is set up, and makers of patented apparatus feel aggrieved when their products do not show the same exceptional and impossible figures. When the professor doffs his gown and ascends to the region of the practical, he is apt to bring with him his inflated percentages, and comparative testing work goes to that engineer who will swear to the most impossible figures. The whole system is pernicious, and it is really very questionable if students benefit much by testing college plant with its all ways round multiple systems of connecting up that are not met with in practice. A commoner type of plant and makeshift methods carried out by the students themselves would give them better ideas of actual conditions. In the plant at Ohio University, described by Mr. Hitchcock to the American Society of Mechanical Engineers, we find a form of furnace that is somewhat uncommon on this side. It is styled the Dutch oven, and consists simply of what we should here call an external furnace to a water-tube boiler, of such a design that the firebrick arch over the grate extends beyond the grate, and so far the style of furnace is good, though immediately beyond the arch the gases pass directly between the tubes overhead, though they might, we think, with advantage have been carried further back so as to travel parallel with the tubes on their return path. Evaporative tests have been rather overdone; combustion tests have been neglected. What is wanted is a series of tests on furnace arrangements, especially in respect of the proportion of firebrick employed, the thickness of fires and so on in relation to draught intensity and the result in percentage of CO_2, absence of smoke and final or flue temperature. Many tests might be made which need not take account of evaporation. The paper gives a very complete record of the method of testing employed and of the apparatus used, but does not tell if the results were obtained with or without smoke formation, though it is notable that a 46 per cent. in one case gave a percentage of carbonic oxide double that which resulted from an excess of 66 per cent., and treble that due to 89 per cent. of excess air, figures which point possibly to insufficient mixture or too rapid cooling, or both. In the long run, however, the trial with the smallest excess of air gave the highest evaporation.

Bolt Stresses.—A paper on the stresses due to tightening up bolts, such as that presented by Mr. Bement to the American Society of Mechanical Engineers, might be amplified very considerably had anyone made notes of breakages. An ordinary nut and bolt form a very powerful combination, and many erectors and fitters do not seem to realise the power they exert. They are far too apt to screw things up unnecessarily tight. Cylinder and valve chest covers only need to be tight enough not to leak at maximum pressure. Nuts ought to run easily on their bolts, so that they can be tightened close by hand, and made firm with a short key and gentle pressure. Then, when the engine is started, should steam blow, a firmer pressure must be gradually put on—not too much at one time on any one bolt, but a bit at a time all round, without excess on any. A bolt ought to be called upon to bear as little as possible beyond the steam pressure stress. There is no reason to-day why cylinder flanges should be made to overhang the joint circle without contact. The outer circumference of a pair of abutting flanges ought to be a trifle slack, so that the stress of screwing up may be greatest on the joint strip, but the amount of closure possible to the bolts ought not to exceed a minute fraction. It should not be such as to endanger the angle of the flange by bolt pressure. Stresses of erection and fitting up are often far in excess of what is necessary.

Marriage.—Mr. C. W. Bentley, resident engineer and secretary of the Alderley Edge and Wilmslow Electric Supply Co., was married to Miss Sallie G. Bell, of South Shields, on Tuesday last week.

The Patent Exploitation Case.—From the announcement which appears among our advertisement pages to-day, it will be seen that the Patent Exploitation, Ltd., is appealing from the recent decision of Mr. Justice Buckley.

London County Council.—The Council at its meeting on Tuesday decided to advance £3,019 to the Battersea Borough Council for the purchase of additional electric lighting plant. An expenditure of £150 was sanctioned for the purpose of allowing the chief engineer to visit America to inspect the tramway subway and surface tramway works in New York and other cities.

Appointments Vacant. — Engineer-in-charge for Wimbledon (£78); draughtsman for the Blackburn mains department; cable jointers for Durban (15s. per day); shift engineer for Tunbridge Wells; two pupils for Southwark electricity works; tramways inspector for Birkenhead (35s.); switchboard attendant for Burnley (£78); assistant to the secretary of the I.E.E. (£200); assistant electrical engineer for Bray (£80); demonstrator in electrical engineering for Manchester Municipal School of Technology (£120). See "Official Notices" to-day.

THE CENTRAL STATION ENGINEER.

Out of 72 applicants, the Electric Lighting Committee of Battersea Borough Council has appointed Mr. T. Bennett, of Bedford, shift engineer.

The employés at Montrose Electricity Works went for a walking match round the Basin on Friday last.

Mr. Harry Webber, of the Dover Electricity Supply Co., Ltd., is the successful candidate for the position of chief assistant engineer at the Hastings Corporation Electricity Works.

Consequent upon Mr. J. B. Morgan, superintendent of mains, securing the appointment of electrical engineer at Horsham, Worcester T.C. has made the following promotions on the Electricity Works staff:—Mr. T. Birrell, chief assistant engineer, to be mains superintendent at £135 per annum; Mr. A. B. Cope, second engineer, to be chief assistant engineer at £120; Mr. S. Burdick, assistant engineer, to be second engineer at £90.

Councillor Grey, the chairman of the Burnley Electricity Committee, took the employés of the electricity department for an outing on July 2nd. The party went by coach to Higher Hodder Bridge, and dinner at the inn was followed by a cricket match between the "Staff" *v.* "The Rest."

The Birmingham Sub Committee appointed to select an engineer to succeed Mr. J. C. Vaudrey, has, after interviewing several gentlemen, reduced the list to four. The four hail from Belfast, Bradford, Chester and York respectively, and the final vote was to take place on Wednesday.

The salary of the resident electrical engineer at Edinburgh has been increased from £750 to £850 per annum.

NEW COMPANIES REGISTERED.

Sprinkler Co., Ltd. (77,753).—This company was registered on June 18th, with a capital of £15,000 in £1 shares (10,000 preference), to acquire any mechanical engineering, electrical or chemical device or process for preventing, detecting or extinguishing fires, to manufacture and deal in machines, apparatus and appliances, &c. The first subscribers are:—W. Hellewell, 51, Aldermanbury, E.C., solicitor, 4 shares; S. H. Cairns, 35, Conyers Road, Streatham, solicitor, 1 share; H. W. Patey, 42, Finsbury Square, E.C., solicitor, 1 share; A. Patey, 42, Finsbury Square, E.C., solicitor, 1 share; A. N. Scott, 18, Ironmonger Lane, E.C., chartered accountant, 1 share; L. O. Huggins, 18, Ironmonger Lane, E.C., chartered accountant, 1 share; and N. L. Scott, 20, Ironmonger Lane, E.C., engineer, 1 share. No initial public issue. Table "A" mainly applies.

Uddington District Electric Lighting Co., Ltd. (77,856.)—This company was registered on June 27th, with a capital of £1,000 in £1 shares, to carry on, in Bothwell, Co. Lanark, the business of electricians, mechanical engineers, and suppliers of electric light in all its branches. The first subscribers (each with one share) are:—T. Trimmell, 27, Cannon Street, E.C., solicitor; A. Clements, 83, Cannon Street, E.C., secretary; C. Collins, 69, Clifton Crescent, Peckham, S.E., clerk; J. Gray, 58, Comeragh Road, West Kensington, patent agent; A. J. Tanner, Tobermory, Bounds Green Road, New Southgate, N., gentlemen; A. C. Lewis, 83, Cannon Street, E.C., director; and G. H. Kiek, 106, Grove Lane, Denmark Hill, S.E., clerk. No initial public issue. Registered without articles of association. Registered offices, 83, Cannon Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

London and Provincial Electric Construction Co., Ltd. (69,316).—A mortgage or charge dated May 26th, 1903, to secure £500, charged on the company's undertaking and property, including uncalled capital (such charge on capital to be a floating security, and subject to any other charges to secure not more than £3,000), has been registered. Holder: W. H. Halford, 36, Cornhill, E.C.

Penarth Electric Lighting Co., Ltd. (52,912).—This company's annual return was filed on May 13th, when 2,500 "A" shares had been taken up out of a nominal capital of £50,000, in 2,500 "A" and 2,500 "B" shares of £10 each. £8 has been called up on 2,449 shares and £1 on one share, resulting in the receipt of £19,993. No mortgages or charges.

Direct Spanish Telegraph Co., Ltd. (6,732 C.).—This company's annual return was filed on April 20th, when 12,931 ordinary and 6,000 preference shares had been taken up out of a nominal capital of £95,000, in 13,000 ordinary and 6,000 preference shares of £5 each. £5 per share has been called up, resulting in the receipt of £94,655. Mortgages and charges: £30,000 4½ per cent. debentures, redeemable June, 1914.

London and Provincial Electric Construction Co., Ltd. (64,316).—A memorandum of satisfaction in full of a charge dated June 23rd, 1902, securing £150, has been filed.

Monorail Portable Railway Co., Ltd. (59,074).—A memorandum of satisfaction to the extent of £200 of first debentures, and to the extent of £1,100 of second debentures, dated April 23rd, 1902, securing £2,666 13s. 4d. and £5,333 6s. 8d. respectively, has been filed. Previous satisfactions registered: first debentures, £400; second debentures, £2,300.

Derbyshire and Nottinghamshire Electric Power Syndicate, Ltd. (69,618).—A charge dated May 26th, 1903, to secure £2,400, charged on the company's property, subject to charge to the Nottingham and Nottinghamshire Bank, has been registered. Holders: G. H. B. Glasier, 7, St. James's Street, S.W.; J. T. McCraith, J.P., Park Valley, Nottingham; E. H. Fraser, J.P., Wellington House, Nottingham; J. W. Thackeray, College Hill, Nottingham; and T. H. Jackson, The Manor House, Birkenhead.

Renewable Electric Lamp Co., Ltd. (65,144). — Issue on June 9th of £500 second debentures, part of a series created April 2nd, 1903, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Frank Suter & Co., Ltd. (57,193).—This company's annual return was filed on May 23rd, when 2,050 preference and 13,404 ordinary shares had been taken up out of a nominal capital of £20,000 in 6,500 preference and £13,500 ordinary shares of £1 each. £1 per share has been called up on 2,050 preference and 3,404 ordinary shares, resulting in the receipt of £5,404. 10,000 ordinary shares are considered as fully paid. Mortgages and charges, £7,000.

Folkestone Electricity Supply Co., Ltd. (51,825).—This company's annual return was filed on April 24th, when 15,000 shares had been taken up out of a nominal capital of £100,000 in 20,000 shares of £5 each. £5 per share has been called up on 10,000 and £2 on 5,000 shares, resulting in the receipt of £60,000. Mortgages and charges, £50,000.

Evershed & Vignoles, Ltd. (43,206).—This company's annual return was filed on May 6th, when 2,200 shares had been taken up out of a nominal capital of £30,000 in 3,000 shares of £10 each. £10 per share has been called up on 1,618 and £7 10s. on 582 shares, resulting in the receipt of £20,545. Mortgages and charges, £12,020

Guildford Electricity Supply Co., Ltd. (36,725).—Issue on May 26th of £400 debentures, part of a series created November 19th, 1900, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £13,400.

Kent Electric Power Syndicate, Ltd. (72,742).—An agreement and charge dated May 21st, 1903, to secure £1,500, charged on the company's unissued and increased capital, and its undertakings and assets, present and future, has been registered. Holders: Lord Avebury, A. J. Roberts, W. C. Curtis, H. J. Lubbock, C. Chaplin, T. E. Roberts, the Hon. J. B. Lubbock, and G. C. Curtis, all of 15, Lombard Street, E.C.

Longstreths, Ltd., Electricians, London (64,823).—£500 second debentures, created May 28th and dated June 10th, 1903, charged on the company's property, present and future, including uncalled capital (subject to any outstanding mortgage debentures issued in 1901, and to any debentures subsequently issued in accordance with Condition 14), have been registered. No trustees. One £100 debenture of this series issued to A. Baker.

Rosling & Fynn, Ltd., Electrical Engineers, Bradford (66,319).—A memorandum of satisfaction in full of a trust deed securing £9,500 has been filed.

Aberystwyth and Chiswick Electricity Supply Corporation, Ltd. (38,851).—Issue on May 27th of £500 debentures, part of a series created by resolutions of November 2nd, 1900, and May 8th, 1901, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £27,500.

Cuba Submarine Telegraph Co., Ltd. (4,710 C).—This company's annual return was filed on May 20th, when the entire capital of £220,000, in 16,000 ordinary and 6,000 preference shares of £1 each, had been taken up and paid for in full. No mortgages or charges.

Indo-European Telegraph Co., Ltd. (3,953).—This company's annual return was filed on May 20th, when 17,000 shares had been taken up out of a nominal capital of £450,000, in 18,000 shares of £25 each. £425,000 has been paid. No mortgages or charges.

West Coast of America Telegraph Co., Ltd. (52,114).—This company's annual return was filed on May 21st, when 45,008 shares had been taken up out of a nominal capital of £182,520, in 53,008 shares of £2 10s. each; £2 10s. has been called up on 8 shares, resulting in the receipt of £20; £112,500 is considered as paid on 45,000 shares. Mortgages and charges: £170,000.

Hartlepool Electric Tramways Co., Ltd. (49,734).—This company's annual return was filed on May 5th, when the entire capital of £100,000, in 5,000 ordinary and 5,000 preference shares of £10 each, had been taken up. £10 per share has been called up on the ordinary and £3 7s. per share on the preference shares, resulting in the receipt of £66,750. No mortgages or charges.

General Electric Tramways Co., Ltd. (43,428).—This company's annual return was filed on May 5th, when the entire capital of £18,500, in £1 shares had been taken up and paid for in full. Mortgages and charges: £15,000.

ELECTRICITY SUPPLY ACCOUNTS.

Sunderland Corporation Electricity Department.

THE returns for the eighth year's working of the electricity department of the Borough of Sunderland bear evidence of steady progress both in the matter of output, and in what is perhaps of greater importance, the ability to satisfactorily deal with the growing power load, which on the banks of the Wear may easily eclipse the tramway and lighting supply during the next few years. It is, in fact, due to the recent large works extensions that the department finds itself faced with a deficit on the year's accounts. Three 1,100 H.P. three-phase generators and additional boiler plant is being installed at the Hylton Road station, and sub-stations are being erected in proximity to the engineering and shipbuilding yards. Mr. John F. C. Snell is the borough electrical and tramways engineer.

GENERAL STATEMENT.

For year ending March 31st—		1902.	1903.	Inc.
Total capital expended	...	£197,282	£225,996	£28,714
Number of units sold	...	2,375,557	2,848,283	472,726
Equivalent number of 8-C.P. lamps		66,932	82,653	15,721
Number of public lamps	...	60	157	97
Number and horse-power of motors		93	140	47
		= 637 H.P.	= 927 H.P.	= 290 H.P.
Maximum load in kilowatts	...	1,640	2,165	525
Revenue Account. Gross revenue	...	£26,578	£31,325	£4,747
" expenditure	...	£15,212	£18,509	£3,297
" profit	...	£11,366	£12,816	£1,450
Average price obtained per unit	...	2·64d.	2·60d.	—·04d.

It will be noted that the average price obtained per unit remains practically unaltered, and, compared with the previous year, motive power and public lighting units show increased percentages, while tramways show a slightly decreased percentage of the total supply. The relative numbers of units supplied during the past two years are as follows:—

Year.	Lighting.	Motors.	Tramways.	Public lighting.	Total.
1902 ...	805,016	197,121	1,232,910	140,500	2,375,557
1903 ...	917,368	299,855	1,335,660	295,400	2,848,283

The prices charged are, for private lighting, 5d. and 2½d. per unit; power, 2½d. per unit, with discounts down to 1½d.; public arc lamps, £16 per annum.

The works costs show a fractional increase over the previous year, due to temporary causes. The item for coal shows a satisfactory decrease of ·14d. per unit; this is, however, neutralised by increased repairs, wages and taxes items, due to running two stations, and to some building alterations charged to revenue.

REVENUE STATEMENT.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
By sale of energy ...	26,176	2·64d.	£30,835	2·60d.	—·04d.
Meter rentals, &c. ...	402	·04d.	490	·04d.	·00d.
Gross revenue ...	£26,578	2·68d.	£31,325	2·64d.	—·04d.

WORKING EXPENSES.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
Coal	£7,194	·73d.	£7,007	·59d.	—·14d.
Oil, waste, water, and engine room stores	699	·07d.	810	·07d.	·00d.
Wages incurred in generation and distribution, and attending public lamps	2,936	·19d.	2,627	·22d.	·03d.
Maintenance and repairs of plant, machinery, mains, &c., and public lamps	1,212	·12d.	2,655	·22d.	·10d.
Works and distribution costs	£11,441	1·11d.	£13,099	1·10d.	—·01d.
Rent, rates and taxes	1,470	·15d.	2,623	·22d.	·07d.
Management and general expenses, salaries of engineer and clerical staff, stationery, printing, law and insurance	2,301	·27d.	2,786	·23d.	—·04d.
Total works costs..	£15,212	1·53d.	£18,508	1·55d.	—·02d.

PROFIT STATEMENT.

	1902.	1903.
Interest on loans	£4,685	£6,756
Sinking fund	4,743	6,460
Balance on year's working	1,938	—400
	£11,366	£12,816

During the year the department earned a gross profit of £12,816, which was, however, insufficient to meet the increased financial charges consequent on the large extensions, and a deficit of £400 resulted. As, however, the department has earned large surpluses during the four previous years, and is entering on the most profitable class of business, the deficit is of small moment.

CITY NOTES.

British Aluminium Co.

MR. J. D. BONNER presided at the meeting of this company on Tuesday at Winchester House. In moving the adoption of the report, he said that considerable progress had been made in overcoming the difficulties which beset the company 12 months ago. Although, owing to the circumstances of the company, last year's trading had to bear an abnormal expenditure of some £2,000, the profit was some 60 per cent. greater than in the previous year. That was the more satisfactory, having regard to the fact that the improvement in the business only became pronounced in the second half of the year. The improvement had been more than fully sustained during the current year. The suspense account still stood at some £80,000, the total adjustments having only had the effect of reducing the original figure by some £250. They proposed dealing with the suspense account as a whole a little later on. The demand for the metal continued satisfactory throughout the world. So far as their own market was concerned, their sales this year had been very materially in excess of those in the corresponding period of last year, and, moreover, that increase had been well distributed over all sections of the business. There had consequently been a material reduction in the amount of metal accumulated in stock. Two years ago the amount of stock was equivalent to more than two years' total of the sales then being effected, while to-day, owing to the improvement in sales and reduction in stock having gone on simultaneously, they had now less than a nine months' supply on hand at the rate at which they were now selling. They, however, thought that, as a matter of policy, they should always have considerable reserve of stock, and they had, therefore, decided to increase the production at Foyers as soon as the necessary furnaces could be erected. It was hoped that these would be ready late in the coming autumn; but at all events, it was practically certain that before the end of the year a material increase in production would be assured. That increased production, would, of course, involve consumption of a larger quantity of alumina and carbon; consequently, as the alumina works at Larne, and the carbon works, were only sufficient to meet the requirements of present customers, they had no alternative but to proceed with the extension of those works also, and steps were already being taken to that end. The quality of the aluminium which they were now producing was exceedingly good, the average for the year being about 99·4 per cent. purity. Regarding the understanding

which existed between this company and the other aluminium producers, the revision of the basis terms of that understanding was arranged at a conference which took place early in the present year. They did not succeed in obtaining all that they considered they were entitled to; but they recognised that there was an evident desire to meet their wishes, and they decided, therefore, to content themselves for the present with the concessions which they accepted. The new arrangement took effect as from January 1st last, and the profits for the current year would be favourably affected by it. A considerable reduction had been effected in the cost of manufacture of carbide. They hoped that the cost might be still further reduced, and therefore they had resolved to continue its production, in the hope that the market price would enable them to earn a reasonable profit. Consequently the whole of their present available water power would be utilised, and as it was possible that later on further power might be required for the production of aluminium, the board had decided to proceed with the erection of two more dynamos. That step, with the accompanying necessary works, would involve an outlay of nearly £15,000, but the expenditure would be extended over a period of not less than 18 months, which would be required for the completion of the work. They would also have to increase the housing accommodation for the larger number of workmen employed at Foyers. All of those extensions would involve them in an outlay of not far short of £40,000, but the board hoped that the improved position of the business would enable this sum to be provided from the internal resources of the company. They hoped to be able to provide the whole of it without making any fresh issue of capital or increasing the debenture debt. Under the arrangement made with the debenture stockholders, the directors had the right to ask their trustee to postpone the payment of the interest on the debenture stock for a further period of 12 months, but having considered all the circumstances of the case the board had decided not to solicit that concession.

Mr. WOLFENDEN seconded the resolution, which was adopted unanimously.

Mr. ROGER WALLACE, K.C., proposed the re-election of Lord Kelvin and Mr. R. Heath as directors. This was carried unanimously, and

Lord KELVIN, in thanking the meeting for his re-election, said he felt that the work was in good hands now, and there was every prospect of great improvement in the future.

The auditors having been re-elected, a vote of thanks to the chairman closed the meeting.

New General Traction Co.

THE seventh annual meeting of the shareholders of the above company was held on 2nd inst. at Salisbury House, London Wall, Baron E. B. D'Erlanger presiding.

The CHAIRMAN, in proposing the adoption of the report, said that the substance of it might not be all that they hoped for, but they had endeavoured to meet the wishes expressed by several of the shareholders last year for fuller information. The accounts called for very little comment. They had made a gross profit of £17,299 11s. 1d. £8,365 18s. 10d. of that amount had been derived from income on tramways or dividends on securities held by the company, and of the balance of £8,931 4s. 9d., £8,100 was construction profit. After deducting from the gross profit the general expenses, interest on loans and debenture charges, there remained a net profit of £2,521, and adding that amount to the £11,662 3s. 9d. unappropriated balance of last year, the amount standing to the credit of the profit and loss account at the close of the year was £14,183 3s. 11d. Considering the bad times through which the company had passed, and from which it might be said to be only just emerging, he thought they would concur with the board, that it would not be prudent or wise to distribute that money, and therefore they recommended that it should be carried forward to the next account. A new item in the balance-sheet was an amount of £40,150 6 per cent. loan secured, which represented a portion of the loan of £54,000 which they authorised last year, the remainder having been called up since the date to which the accounts were made up. Passing on to speak of the prospects of the individual companies in which the company was interested, he said the shareholders would have noticed that the company was being gradually converted by the force of circumstances from a construction to a trust company. Their interest in the Douglas Co. had not varied—they owned £12,262 in 7 per cent. preference shares and £9,668 in ordinary shares, which last year earned them a dividend of 6 per cent. The season last year was a bad one, and he was glad to say that so far this year they had been much better, and they looked forward to good dividends if the weather continued as it was at present. With regard to Coventry, the Corporation expressed a strong desire to see a line built from Coventry to Arley, which would place it in direct communication with the Midland Railway, and free them from the monopoly of the London and North-Western Railway Co. Negotiations were therefore entered into between the company and the Corporation, and it was mutually agreed that the company should promote a Bill with that object, and the Corporation agreed to grant the tramway company certain valuable extensions and to remodel entirely in its favour the re-purchase clause which they now held. They now held a perpetual concession of the Coventry tramways, subject to the right of the Corporation every seventh year to purchase the tramways as a going concern. He was sorry to say that the new tramway from Coventry to Arley was thrown out, but the other extensions were unopposed. Here he would like to say that it was no wonder that British manufacturers found it hard to compete with other countries, for it actually cost them more for the carriage of the lamp poles from Liverpool to Coventry than it did to bring them from Philadelphia to Liverpool. With regard to the Norwich tramways, the receipts last year were greatly affected by the unfavourable weather and by the great trade depression that prevailed; but he was glad to say that the receipts there had shown a steady improvement since the autumn. It had always been the constant aim of the directors of that company to foster the most cordial relations between themselves and the Corporations they had to deal with, but duty compelled him to say that that aim had never been fully appreciated or reciprocated by the Norwich Corporation. There seemed to be a feeling in Norwich that the tramways there ought to belong to the municipality, and it was to that feeling that he attributed the fact that so far the Corporation had refused to allow them to have advertisements on the trams. The Corporation being desirous of obtaining a piece of land belonging to the Norwich Tramway Co., it was agreed after negotiation to cede the land to the Corporation for £2,000, which was far below its actual value, on the condition that the Corporation should grant the company the right to have advertisements in the cars, the Corporation to receive 25 per cent. of the receipts above £600. At the last moment the Corporation wished to insert a clause in the agreement providing that the receipts from advertising should not be taken into account if they wished to purchase the tramways. Naturally, the company could not accept such an unfair clause, and the negotiations had fallen through. Coming to the Philadelphia tramways, in which the company had a very large stake indeed, he told them at the last meeting that they were expecting every day a judgment of the Supreme Court giving a decision about the possibility of entering into the suburbs over a portion of line belonging to their competitors. The decision was not given until October 13th last, and the Supreme Court reversed the decisions given in their favour by the Lower Courts. Mr. Hopkins, the managing director, during his recent stay in Philadelphia, had taken steps to overcome the difficulties with which the company found themselves confronted, and new rights of way into the suburbs had been acquired, and the laying of the track was now proceeding satisfactorily. He felt sure that, given time for development, that line would prove a most valuable asset. During the past year they had secured the concession for a tramway from Mexborough to Swinton, in Yorkshire. The concession was certainly valuable, but whether or not it would be possible in these times to find the necessary money for carrying out the work was a matter still open to question. The Chairman then went at length into the question of the alleged over-capitalisation of the companies in which the shareholders were interested, and quoted figures to show that whereas the average per mile of tramways in which the company was interested was £13,312; in the case of a series of companies which he named the average was £25,000 and in the case of a number of corporation tramways £18,652. He said he felt confident that if they allowed the necessary time for the various undertakings to properly develop, they would ultimately yield a reward for the patience they had had, and still might have to exercise. In conclusion, he said that £40,000 more would be required in the case of the Philadelphia trams, but before the money was actually wanted, Mr. Hopkins had written them saying he hoped that he would be able to sell in the United States a sufficient number of the bonds of the Philadelphia enterprise to meet those requirements. Should, however, that not be possible, they would have to make some temporary arrangements.

The Hon. A. G. BRAND, M.P., seconded the motion, which after a short discussion was agreed to.

Chili Telephone Co.

THE directors' report to be presented at the meeting to be held on July 16th, reads:—The aggregate number of subscribers at all centres at the end of the year (March 31st, 1903), was 5,371 as compared with 4,981 at the beginning, or a gain of 390 for the year.

The gross revenue in Chili from all sources was:—	
In 1902—3	$841,193
In 1901—2	759,139
An increase of	$82,054
The expenditure in Chili was:—	
In 1902—3	$401,519
In 1901—2	365,776
An increase of	$35,743
The net income in Chili from all sources was:—	
In 1902—3	$439,674
In 1901—2	393,362
An increase of	$46,312

The average rate of exchange for the year was 15·68d., as compared with 14·85d. in the previous year, giving an increase for the year of 0·83d. Converted into sterling at these rates, the figures given in the preceding paragraph are:—

In 1902—3	£28,723
In 1901—2	24,340
An increase of	£4,383

The liquid assets and liabilities in Chili on March 31st, 1903, were valued at 16$\frac{1}{2}$d., the current rate of exchange on that day, as compared with 13$\frac{3}{4}$d. at which they were valued on the corresponding date of the previous year. The increase in the value of the liquid assets over liabilities in Chili due to this rise in exchange amounts to £1,455, which has been carried to reserve. The balance to the

credit of the revenue account, including £2,733 brought from the previous year, is £26,100, of which £11,088 has been carried to reserve for renewal of plant, &c. The directors recommend the payment of a dividend of 6s. per share, less income tax, being at the rate of 6 per cent. per annum, absorbing £12,375, and leaving a balance of £2,637 to be carried forward. The total mileage was:

	Miles.	Yards.
On March 31st, 1903	9,205	892
" " 1902	8,754	527
An increase of	451	365

Electric Construction Co.

THE directors' report, which was submitted to the meeting held yesterday, at Winchester House, E.C., reads:—

The net profit of the year is £20,736 19s. 9d., and, adding the balance brought from last year, £3,504 6s. 1d., the amount available for distribution is £24,241 5s. 10d. Your directors recommend that this profit be appropriated as follows:—

Dividend at the rate of 7 per cent. per annum on the preference shares (to be paid on July 31st next)	£4,394 12 0
Dividend at the rate of 6 per cent. on the ordinary shares (one-half to be paid on July 31st next, and one-half on January 30th, 1904)	13,452 0 0
General reserve fund	2,000 0 0
Balance carried forward to next account	4,394 13 10
	£24,241 5 10

The general reserve fund will then amount to £34,000. The buildings and plant have, as formerly, been thoroughly maintained out of revenue, and £5,000 has been credited to depreciation account, which now amounts to £48,000. The past year has developed increased competition among both home and foreign manufacturers of electrical machinery, with the consequent reduction in prices, but the company has successfully maintained its position, and the net result of the business is approximately the same as last year. Your directors have therefore much pleasure in recognising the ability and skill of the management and men, by recommending the distribution among them of the usual bonus. The new financial year opens with a larger volume of orders in hand than at the same time last year, including contracts for two important installations of electrical plant, one for His Majesty's Government in Gibraltar, and the other for the Corporation of Wellington, New Zealand. The traffic and net revenue of the Madras Electric Tramways continue to grow satisfactorily, and according to present prospects the improvement will be more than maintained in the current year.

Urban Electric Supply Co.

THE annual general meeting of this company was held on Thursday of last week at the offices, Broad Sanctuary Chambers, Westminster, Mr. Francis E. Gripper, M.I.E.E., presiding.

The CHAIRMAN, in proposing the adoption of the report, said that when he met them last year he gave them particulars of the formation of the company which had then only recently been completed. They had met rather later this year because seven of their undertakings were opened and at work during the course of the past year, and the accounts of those had had to be audited, not only by their own auditors, but also by the official auditor of the Board of Trade. They would see by the balance-sheet that the issued capital of the company had now all been called up. They would probably notice that practically the whole of the capital that had been provided had been expended, and with their knowledge of electric lighting undertakings, they would readily understand that the profitable development of such business required further capital from time to time. The directors had arranged with Edmundson's Electricity Corporation to advance any sums that might be required during this year, so that it would not be necessary to make any further capital issue at present. The form which the new capital would take was a matter which he thought they might safely leave in their hands, as it would depend on the conditions existing at the time of issue. An official quotation on the Stock Exchange had been granted for both the ordinary and preference shares. The result of the first year's working had been very encouraging. Although the various stations were running on an average for less than six months, there had been a working profit of £2,264, which, after paying establishment charges, had left a balance of £1,371, to be applied towards the payment of the guaranteed dividends. Those dividends were duly paid on April 1st and October 1st, and again on April 1st of this year. If they looked at the table in the report which gave particulars of the progress at the various towns, they would, he thought, agree with the directors' statement in the report that the prospects of the company were satisfactory. At this time last year they had about 10,000 lamps connected, while they had now the equivalent of over 87,000 lamps connected to their mains—an excellent result for the first year—and he thought this year they might look forward to being able to pay the dividends upon the preference shares, at any rate, without having to call upon the guarantors. The works at Newton Abbot and Grantham had been opened since the end of the year under review, and before the end of this year they would have works in operation at Berwick, Caterham, Newbury and Glossop. At Bishop Auckland, for which town the company possessed statutory powers for lighting, no works had been commenced, as the directors were doubtful whether under circumstances that had arisen, there was a sufficiently good opening to warrant them in putting down a station in that town. Arrangements were in progress for transferring that undertaking to another company who had special facilities for dealing with the district. Valuable extensions to their Twickenham undertaking had been obtained by agreement with local authorities of the adjoining districts of Teddington and Hampton, and further extensions would probably be obtained in this neighbourhood. The tramways between Camborne and Redruth were opened for traffic in November last, and the results of the few months' working had been very encouraging, although it was difficult to estimate the full results until after a complete year's working. A very considerable revenue was expected in connection with the carriage of minerals—a contract having been entered into with one of the largest tin mines of the district for carrying the whole of their ore from the mines to the stamps.

Mr. W. PAGE seconded the motion, and the report was adopted.

Thomas Parker, Ltd.

THE directors' report to April 30th, 1903, to come before the meeting next Monday reads:—

After writing off the various depreciations, as in former years, the balance standing to the credit of profit and loss account is £4,871 16s. 11d.: out of this the directors propose to pay a dividend at the rate of 6 per cent. per annum, less income-tax, amounting to £4,223 17s. 9d., leaving £647 19s. 2d., out of which it is proposed to write off the £500 guaranteed to the Wolverhampton Exhibition, and carry the balance of £147 19s. 2d. forward to next year's account. The result of the last year's working is apparently not so good as shown on balance sheets of recent years, but on careful examination of the profit and loss account and the joint managers' reports, the directors find considerable prospects for the near future. The reasons of the reduced profits is entirely due to decreased output from the works. This is accounted for by the necessity of accumulating stock parts of new designs which have been devised to meet the rapid changes due to recent developments and the requirements of the market. Consequently it has necessitated a large amount of work to accumulate stock and to design special tools to meet these conditions, and to reduce cost of production. This work is now completed, and, as the works are full of orders, the directors look forward to reaping the advantage of this policy during the present year.

Greenwood & Batley, Ltd.

THE meeting of this company was held on Saturday last at 16, Great George Street, S.W., Mr. Arthur Greenwood presiding.

In moving the adoption of the report, the CHAIRMAN said that the profit realised during the past year fell considerably below that earned during each of the two preceding years, and was not such as would enable them to make any additions to their reserve account. The prosperity of the two preceding years was largely due to the extra productions of their ordnance department, caused by the South African war. He referred to some remarks he made in 1900, when he pointed out the changes that were taking place in the nature of the company's business, and their markets. It was due to the fact that the foreigner was now producing for himself those goods which, a comparatively few years ago, were their own speciality. He would like to emphasise those remarks, and to point out that those changes were still going on. They were developing new branches of business to replace those that were lost. Whereas a comparatively short time ago some three-fourths of their productions went abroad, the position was now reversed. A further shortage in the profits was due to the lack of foreign orders in practically all these departments. Russia and Germany had been the worst in that respect, practically no orders coming from those countries. Referring to the various departments, he said that the electrical department continued to make good progress, and fully justified their expectations. Their steam turbine business, which was in close connection with the electrical work, was also making good progress, and although they had not yet realised direct profits from the manufacture of turbines, due most probably to the fact that they were not in a position to manufacture all the varieties at their Leeds works, they had been getting a profitable return through their sale, and their connection with the company's electrical work. The question of manufacture was rapidly improving as they were getting their plant to work to produce all sizes and varieties. In regard to the electrical department itself, he had to tell them of a new departure, which he might say was now fairly launched. It was the manufacture of electrically-propelled motor cars. A new system had been secured by the company, and arrangements had been made with the Electromobile Co., Ltd., who were successfully introducing those motors in the form of landaus, coupés, &c., in London. A considerable quantity of these carriages were now running about London, and the company were turning out quite a number of them monthly. They were most elegant and successful carriages, and appeared to be coming into very general use; they were looking forward to a large trade in them. From the balance-sheet they would see that the company had written off £5,000 for depreciation, as against £7,500 the previous year; but on the other hand, they had expended during the past year about £7,500 in maintenance, as against £4,250 in the previous year. They had also spent a considerable sum of money on additions to plant and buildings—£10,675—as against £6,307, and he was sorry to say that that was an increasing necessity. Competition compelled them to increase their plant and facilities for manufacture, and unless those were powerful and efficient, they would not be able to compete or to advance in those new branches of manufacture that they were developing. There was an item of nearly £4,000 for expenditure on light railway orders, &c. He was glad to inform them that the light railway which they promoted in the Colne district was now being rapidly constructed, and it was hoped to have the first section open for public traffic early in the autumn. As to the prospects for the coming year, the extraordinary expenditure in connection with the war stores was for the present ended, and they might assume that the demand for those stores had assumed normal proportions. Orders in that department were satisfactory, and should keep it fairly well employed throughout the year. The machine tool trade is dull, and the textile machinery department very dull; but they were not without orders in these two departments. Their electrical department and their oil mill machinery department were very full of work. He did not therefore take a despondent view of things, but on the contrary, thought that the outlook was a distinctly hopeful one.

The motion was seconded by Major-General E. MICKLEM, and adopted.

Diesel Engine Co.

Mr. Thomas Snape presided at the meeting held at Cannon Street Hotel on July 2nd. In moving the adoption of the report, he said salaries and office expenses, which amounted for the year to £1,702, showed an increase of over £350, which was accounted for by the larger business done. The profit carried to the balance-sheet was £417. The items on the liability side of the balance-sheet were much the same as last year. The amount received for options was £750, which was paid to them for securing the patent rights for South Africa, and dealing with them over a period of time. The creditors had increased considerably, as had also the debtors. The patent rights stood at the same figure as last year—£350,811. The desirability of depreciating that very large sum had been pointed out, but as there was no balance to apply to the purpose, it was impossible to do so. Last year the loss shown on the balance-sheet was £6,570, and after deducting the £417 profit, the amount stood this year at £6,152. The £6,570, however, was not a loss; it was expended largely in developing and building up goodwill. A circular had been issued taking objection to the accounts. He wished to point out that the loss of 1902, if it were a loss at all, occurred before he joined the board, and before two of his present colleagues had anything to do with the company. Compared with the German and Russian companies, they had made good progress considering the time that the company had been in existence. He asked the shareholders to give the necessary time for the development of the patent.

Mr. W. Grieve seconded the motion.

Mr. H. Waddy, according to the *Times*, severely criticised the management, and moved an amendment, which was ruled out of order. After further discussion, the motion for the adoption of the report was put to the meeting, and lost by 26 votes to 12. At a director's demand, a poll was taken, with the result: For the resolution, 173,993 votes; against, 32,163. The resolution was therefore carried.

The same procedure was adopted with regard to the re-election of directors, excepting in the case of Mr. W. Oppenheimer, who refused to stand again for re-election.

Stock Exchange Notices. — Application has been made to the Committee to appoint a special settling day in and to grant a quotation to—County of London and Brush Provincial Electric Lighting Co., Ltd.—£250,000 4½ per cent. second debenture stock. The Committee has ordered the undermentioned securities to be quoted in the Official List:—British Aluminium Co., Ltd.—10,000 "A" 6 per cent. cumulative preference shares of £10 each, fully paid Nos. 1 to 10,000.

Dowsing Radiant Heat Co., Ltd.—The annual general meeting was held at the company's Institution, 28, York Place, Baker Street, W., on June 11th, presided over by Alderman W. Conolly. The balance-sheet and report were presented and approved, and it was decided to pay a dividend of 8 per cent. out of the available profits, carrying forward a sum of £1,000.

Prospectus.—The Oriental Telephone and Electric Co. has been offering 50,000 6 per cent. cumulative preference shares of £1 each for subscription. The money is needed for converting the company's lines to metallic circuits, and for developing the electrical section of the business. The list was to close yesterday.

St. James's and Pall Mall Electric Light Co.—The directors have declared an interim dividend for the half-year ended June 30th at the rate of 10 per cent. per annum on the ordinary shares.

Telegraph Construction and Maintenance Co.—The directors announce the payment of an *ad interim* dividend of 12s. per share to all shareholders on the register on the 6th inst.

Electric and General Investment Co.—Warrants for the dividends and distributions were posted on 8th inst.

Bruce Peebles & Co., Ltd.—Letters of allotment of shares in this company have been posted.

Meetings.—On Wednesday the meeting of the British Electric Traction Co. was held, also that of the Electric and General Investment Co. Our reports of the proceedings will appear next week. Our account of the United River Plate Telephone Co.'s meeting is also held over.

STOCKS AND SHARES.

Wednesday Evening.

It cannot be said that Stock Markets have received a fillip from either the quarterly disbursements or the visit of President Loubet. True, the Mining Market evinced signs of a revival, but this was due to rumours of the introduction of Asiatic labour being determined on. As something like £6,000,000 was distributed in dividends on the funds, markets should be considerably brighter than they are. This, however, does not refer to the electrical section, which continues to show a good deal of strength, and although there are no advances in quotations to record, there are also no shrinkages, a state of affairs which, on the whole, may be considered very satisfactory.

The Home Railway market has been no exception to the rule, and most of the changes in prices are only fractional. As regards the forthcoming dividends, the market is pretty sanguine, so that any signs of public support would immediately cause an all-round rise in prices. In the Electric Railway group, Central London issues are unchanged and steady, whilst in City and South London, although the quotation is unaltered at 70—72, the Stock has exhibited a weak tone.

Turning our attention to the electric department, there is little to comment on, and despite the strength of the market, business has been on a small scale. Charing Cross Ordinary were rather in demand for investment purposes, and the Debenture stock has also been in request. Citys are steady at about 12, and Countys are harder in tone at 8½—9. Edmundson issues keep in favour, but the quotations are unchanged from last week. Metropolitans were unaffected by the recent decision in the Courts regarding the decree of specific performance asked for by the company, and the price closes steady at 18. The preference are $\frac{1}{16}$—$\frac{3}{16}$ premium, and, moreover, fully-paid shares can now be dealt in, as arrangements have been made with the company to receive payment in full, provided that the dividend is made good as from June 29th last. St. James's are firm and in request at 16—16½. The usual interim dividend at the rate of 10 per cent. has been declared. South Londons are a steady market at 3½—4. Urban Ordinary and Preference have continued to attract the attention of investors since the publication of the report, which, it will be remembered, was a healthy document, and showed a steady and rapid increase in the growth of the business. Westminsters have shown activity at 12¼—$\frac{3}{4}$, and the Preference keep at 6½.

Bournemouth and Poole Electric Ordinary at 12½—13½, are unchanged on the new issue of 4,500 Ordinary shares of £10 each, at a premium of £1 per share. The issue is offered to Ordinary and Preference shareholders at the rate of one new for every five old shares. Transactions on the basis of $\frac{3}{4}$—1¼ prem. over the issue price are only being booked for the special Settlement, as there are no renunciation letters, and because there is a possibility of a difficulty in delivering the shares for some little while. Next Monday is the last day for accepting allotments.

Looking down our list of telegraph and telephone prices there are several alterations to record, of which advances claim the greater number. During the past week this section has been firm, and in many of the securities where no movement is reported there is a distinct upward tendency. Eastern Telegraph Ordinary and 3½ per cent. Preference stocks are both 1 per cent. higher, with a fairly brisk trade passing in them; whilst the Eastern Extension shares have been particularly strong, and close a full point up at 11$\frac{3}{4}$—12¼. On the other hand, the Eastern and South African 4 per cent. Registered Debentures are 2 per cent. lower at 99—102 per cent. Globe Trust Ordinary and Preference have both received a good deal of attention, and the Preference finish ¼ better on the week at 12¼—$\frac{3}{4}$. Submarine Cables Trust is another point to the good at 113—118. In United River Plate Telephone Preferences an advance of ¼ is recorded, and the same may be said of Western Telegraph shares at 11¼—$\frac{3}{4}$, in which some active business has been done. The Debentures of the latter, however, are both 1 per cent. lower, and dealings have been negotiated within the reduced quotations.

Oriental Telephone and Electric Ordinary at $\frac{13}{16}$—$\frac{15}{16}$ are unchanged on the new issue of 50,000 6 per cent. cumulative preference shares of £1 each at par which is being offered to the public, although we understand that ordinary shareholders will receive a preferential allotment. The issue is a good enough thing in its way, and will suit a certain class of investor, but it would have been just as well if the directors had given some idea of the past profits in the prospectus.

Manufacturing and industrial companies are quiet, and on the whole prices keep fairly steady. The British Electric Traction report has been published, and it will be seen that the reduction in the dividend is mainly due to unremunerative capital received during the year under review. It is intended to increase the borrowing powers in order to make an issue of Second Debenture stock. The price of the Ordinaries closes ½ lower at 12$\frac{3}{4}$—13¼. Electric Construction shares have changed hands a few times, and the quotation has narrowed in margin, but without altering the middle figure.

The South Staffordshire Tramways (Lessee) Co., Ltd., made last week an issue of 10,000 6 per cent. cumulative Preference shares of £5 each at par. The additional capital is required for reconstructing lines for electric traction, purchasing electric cars and other purposes.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations July 1st.	Closing Quotations July 8th.	Business done week ended July 8th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3½	2¼— 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	47 — 50	47 — 50	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94	92 — 94	93	92
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8½— 8¾	8½— 8¾	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4½— 5¼	4½— 5¼	..	..
18,333,300$	Commercial Cable	$100	8 %	8 %	8 %	150 —160 xd	150 —160	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	89 — 92 xd	89 — 93	92	90
16,000	Cuba Telegraph	10	4½%	4 %	6½%	6½— 7½	6½— 7½	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15½— 16½	15½— 16½	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3¼	2½— 3¼	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	97 —101 xd	97 —101	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	9¾— 10¼	9¾— 10¼	..	..
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	98 —101 xd	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	124 —129	125 —130	128½	127
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	87 — 90	88 — 91	89½	87
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	104 —107	104 —107	107	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	10½— 11½	10½— 11½	12 3/16	11⅛
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	107	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	101 —104 %	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	..	8½— 9	8½— 9	8⅞	8 3/16
180,042	Do. do. 6 % Pref.	10	..	..	..	12 — 12½	12¼— 12¾	12 1/16	12⅛
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 23	22 — 23	..	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101 xd	98 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	35 — 39	35 — 39	37½	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	102 —104	102 —104	103½	102½
1,966,667	Do. do. Def. Stock	100	..	..	4½%	82 — 84	82 — 84	83¼	82¼
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	12	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5½	5 — 5¼	5⅛	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 98 xd	96 — 98	..	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103 xd	101 —103	102½	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	1 3/16— 15/16	1 3/16— 15/16	1 3/16	1 3/16
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7½	6½— 7½	..	..
3,303	Submarine Cables Trust	Cert.	..	..	..	112 —117	113 —118	..	..
68,000	United River Plate Telephone	5	7 %	7 %	7 %	5½— 6	5½— 6	5½	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5 xd	4½— 5¼	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106 xd	103 —105	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	4 — 5 xd	4 — 5	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	93 — 96 xd	93 — 95	94½	..
267,930	Western Telegraph, Ltd., Nos. 1 to 267,930	10	7 %	7 %	..	11 — 11½xd	11¼— 11¾	11¾	11⅜
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	96 — 99	95 — 98	..	..
88,321	West India and Panama Telegraph	10	1%	..	..	⅜ — ½	⅜ — ½	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6¼	6 — 6⅓	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3 — 4	3 — 4	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	..	..	..	97 —100 xd	97 —100	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	74 — 79	74 — 79	78	77½
100,000	British Electric Traction	10	9 %	9 %	8 %	13½— 14½	12¾— 13½	13 3/16	12 13/16
100,000	Do. do. 6 % cum. Pref.	10	..	..	..	12 — 12¾	11⅞— 12¼	12¼	11⅝
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	124½	123½
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6¾— 7¼	6¾— 7¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾— 6	5¾— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	103 —107	101 —105	104½	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	1/6 — 1¾	1/6 — 1¾	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	2— 1½	2— 1½	1⅝	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1½— 1⅝	1½— 1⅝	1 11/16	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	89 — 94	87 — 92	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	12 — 13	11¼— 12¼	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¾— 6	5¾— 6	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	106 —110	109	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	104 —107	104 —107	105	..
494,093	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	101 —104	101 —104	103½	..
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	107 —110	107 —110	..	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	71 — 73	70 — 72	71	70
85,000	Crompton & Co., Nos. 1 to 85,000	8	8 %	7½%	..	2 — 2½	2 — 2¼	2 3/16	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	102 —106	101 —105	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1½— 2⅛	1½— 2⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	73 — 77	71 — 75	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½— 2	1⅝— 1⅞	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2½— 3	2½— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	100 —103	100 —103	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9¾— 10½	9¼— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 16	14 — 15	..	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5½	5 — 5½	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19½	19½	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5⅞— 6	5⅞— 6	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½— 10⅞	10½— 11½	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	32 — 35	33 — 36	33⅝	33
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	100 —103	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	99 —102	98 —101	100	99½

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring, ⅜—½.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14¼—14¾.
Do. do. Pref. (£10 pd.), 10—10¼.

Bank rate of discount 3 per cent. (June 18, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations July 1st.	Closing Quotations July 8th.	Business done week ended July 8th, 1903. Highest.	Lowest.
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	..	..	..	⅝ — ⅞	⅝ — ⅞	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	8 %	8 %	10¼ — 11	10¼ — 11	..	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	10⅞ — 10¾	10⅞ — 10¾	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅛	9 — 9⅛	9⅞	9⅛
70,000	Do. do. do. 4½% Cum. Pref.	5	..	..	..	5¾ — 6	5¾ — 6	5⅞	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4¾ — 5 xd	4¾ — 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —105 xd	104 —106	105⅜	105½
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	6 — 6⅛	6 — 6⅛	6⅛	..
150,000	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110	107 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	11¾ — 12⅛	11¾ — 12⅛	12	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	13⅜	13⅛
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	121 —126 xd	121 —126	122⅛	122½
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105 xd	102 —104	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	..	..	..	12 — 13	12 — 13	12⅛	..
400,000	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	109 —112 xd	109 —112	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6½ — 7	6¼ — 7	..	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6½	6 — 6¼	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	108 —111	108 —111	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	11 — 12	11 — 12	..	..
90,000	Do. do. do. 4 % Debenture Stock	Stock	..	..	..	103 —106	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2 — 2⅛	2 — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5¼ — 6	5¼ — 6	..	..
250,000	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —103	100 —102	101¼	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6½%	7½%	17⅞ — 18⅛	17⅞ — 18⅛	17⅞	..
220,000	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —112 xd	108 —112	..	..
250,000	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	98½	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13½ — 14½xd	13 — 14	13½	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15¾ — 16½	15¾ — 16½	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8½ — 9½	8½ — 9½	..	..
150,000	Do. do. do. 3½% Deb. Stock Red	100	..	..	..	98 —101 xd	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3½	3 — 3¼	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	12½%	3¾ — 4	3¾ — 4	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	5 — 5¼	5 — 5¼	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5¼	5 — 5¼	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	12⅝	12⅝
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6½ — 6¾xd	6½ — 6¾	..	..

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, July 8th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£19	£2 dec.
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks	per lb.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	136/-	3s. inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 5	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks	per lb.	2½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£130	..
b ,, Wire, in ton lots	per ton	£168	..
b ,, Sheet, in ton lots	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £145	..
c Brass (rolled metal 2' to 12') basis	per lb.	7½d.	..
c ,, Tube (brazed)	per lb.	9d.	..
c ,, ,, (solid drawn)	per lb.	7½d.	..
c ,, Wire, basis	per lb.	7½d.	..
c Copper Tubes (brazed)	per lb.	9d.	..
c ,, ,, (solid drawn)	per lb.	9½d.	..
g Copper Bars (best selected	per ton	£71	..

METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£71	..
g ,, Rod	per ton	£71	..
e ,, (Electrolytic) Bars	per ton	£67	..
e ,, ,, Sheets	per ton	£78	..
e ,, ,, Rod	per ton	£69	..
e ,, ,, H.C. Wire	per lb.	8¼d.	..
f Ebonite Rod	per lb.	3/-	..
f ,, Sheet	per lb.	5/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	3/10½ to 3/11¾	inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	46/5½	3½d. dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£11 15 to £11 17 6	dec.
g ,, ,, Sheet	per ton	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 12 6	..
d Mica (in original cases) small	per lb.	4d. to 1/2	..
d ,, ,, medium	per lb.	2/3 to 3/6	..
d ,, ,, large	per lb.	3/9 to 7/9	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/2	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£125 to £127	dec.
g ,, Foil	per lb.	1/8	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7	..
p White Anti-friction Metals—"White Ant" brand	per ton	£42 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7½d.	..
j ,, 6 lea. Flax	per lb.	5⅝d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4½d.	..
j ,, 10 lbs. Russian, single	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 15	£1 dec.

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakespeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* W. H. Hindley & Co.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

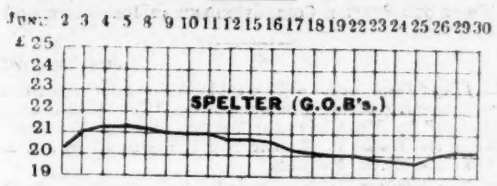
ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	June 27	1,247	— 48	4,864	+ 915	—	—
	Birmingham	July 4	5,395	+562	135,450	+ 6,576	—	—
	Bournemouth	,, 1	1,161	—	—	—	—	—
	Blackburn	June 26	909	—286	11,668	+ 674	12½	+1½
	Blackpool	July 2	954	—537	11,218	+ 1,152	—	—
	Blackpool and Fleetwood	June 30	899	+136	10,625	+ 1,059	7¾	—
	Bolton	,, 28	1,987	—582	24,381	+ 3,161	25	—
	Bradford	July 5	4,061	+470	52,095	+ 9,183	39	+2
	Brighton	,, 5	982	+ 48	65,462	—	6½	—
	Bristol	,, 3	5,375	+310	—	—	28	—
	Burnley	,, 4	795	+ 65	—	—	—	—
British Elec. Trac. Co.	Barnsley District	June 26	196	—	4,443	—	—	—
	Devonport	,, 26	504	+ 9	10,636	+ 291	5	—
	Dudley—Stourbridge	,, 26	891	—105	19,788	+ 1,969	18¾	—
	Gateshead	,, 26	1,120	— 26	21,386	+ 3,866	10½	+ ½
	Gravesend—Northfleet	,, 26	275	—	5,312	—	3½	—
	Greenock—Pt. Glasgow	,, 26	675	—147	12,699	+ 1,153	7½	—
	Hartlepool	,, 26	309	—174	6,207	+ 410	6½	+2
	Kidderminster	,, 26	149	— 34	2,998	+ 177	4½	—
	Merthyr	,, 26	208	— 82	4,845	— 256	3	—
	Middleton	,, 26	402	— 42	7,628	+ 654	8½	—
	Oldham—Ashton	,, 26	611	—127	14,167	+ 1,352	8	—
	Peterborough	,, 26	159	—	3,206	—	—	—
	Poole	,, 26	324	+ 20	6,880	+ 1,135	3½	—
	Potteries	,, 26	1,536	—229	38,750	+ 2,400	29½	—
	Rothesay	,, 26	188	+ 20	2,156	+ 896	—	—
	Sheerness	,, 24	83	—	1,062	—	—	—
	Southport	,, 26	323	—129	7,064	+ 1,616	6½	—
	South Staffordshire	June 26	950	— 59	20,687	+ 1,182	21½	—¼
	Swansea	,, 26	548	—334	11,973	+ 581	5½	—
	Taunton	,, 26	56	— 33	1,394	— 115	1½	+1½
	Tynemouth	,, 26	566	— 86	6,854	+ 856	3½	—
B.E.T. Co.	Weston-super-Mare	,, 24	137	— 13	1,653	— 155	2½	+2½
	Wolverhampton Dist.	,, 26	394	+193	9,594	+ 5,482	10½	+8
	Wrexham	,, 26	140	—	1,770	—	—	—
	Yorks. Woollen Dist.	,, 27	371	—	5,114	—	6	—
	Cardiff	,, 27	2,060	—233	24,268	+ 9,136	—	—
	Dover	,, 27	268	— 27	5,066	+ 14	3	—
	Dublin	July 3	5,768	— 15	119,854	+ 5,749	46	—
	East Ham	,, 4	773	+ 284	9,296	+ 3,002	5	+ ½
	Glasgow	June 6	15,376	+3194	15,376	+ 3,194	65	+13
	Hull	July 4	1,924	+ 184	25,142	+ 1,520	—	—
	Ilkeston	,, 1	220	—	—	—	—	—
	Isle of Thanet	,, 4	1,038	+205	11,766	— 375	—	—
	Leeds	,, 4	6,083	— 87	79,105	+ 5,725	—	—
	Liverpool	June 27	10,774	—4258	253,327	+ 9,725	101	+2½
	Manchester	July 4	12,676	+7354	—	—	110	+55
	Newcastle	,, 4	3,243	+ 608	—	—	17	—
	Portsmouth	,, 4	2,183	—814	—	—	29	—
	Salford	June 29	4,156	+ 637	47,129	+14,110	—	—
	Southampton	July 2	1,163	—405	—	—	—	—
	Sunderland	June 28	1,405	—466	15,432	+ 542	20	+ 2
	Central London Railway	July 4	6,788	—408	6,788	— 408	6	—
	Chatham & District Co.	June 25	590	+ 4	11,829	+11,069	8½	—
	City and S. London Ry.	July 5	2,455	—866	2,455	— 866	6½	—
	Dublin and Lucan Elwy.	June 21	127	+ 16	2,513	+ 81	—	—
	Liverpool Overhead Ry.	July 5	1,672	+ 77	—	—	6½	—

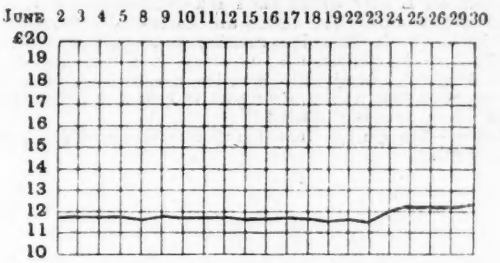
* Compared with the corresponding period of 1902.

METAL MARKET.

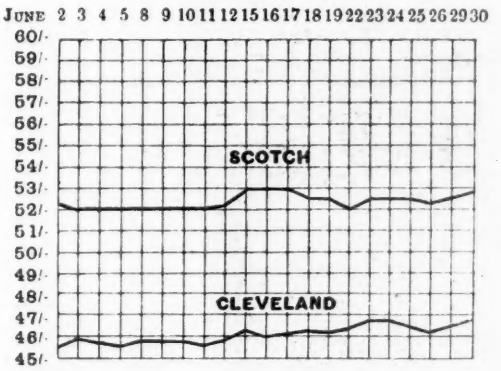
Fluctuations in June.



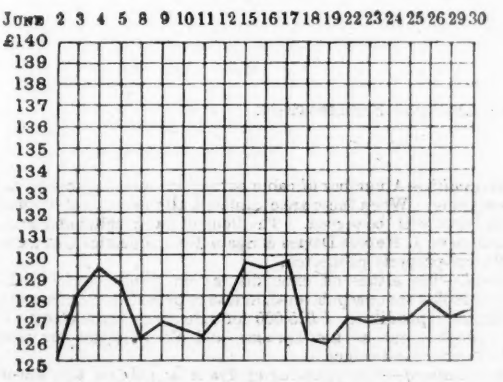
LEAD (ENGLISH).



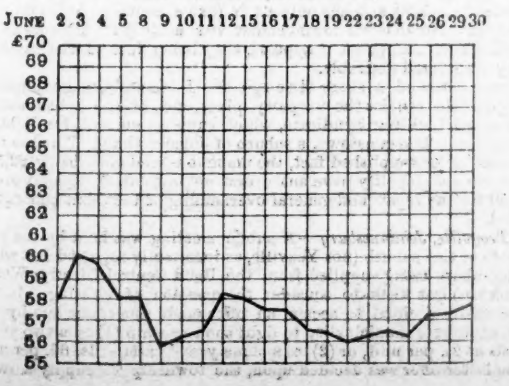
IRON.



TIN.



COPPER (G.M.B's.)



THE LABOUR AND COST OF TENDERING.

The necessity of carefully reading each provision in a specification before submitting tenders for work required was emphasised by the facts elicited in a case heard in the Liverpool County Court on July 1st. In the case in question, Messrs. John Ainscough and Son, contractors, of Oldham, sued Messrs. Beloe & Priest, civil engineers, of Liverpool, for the sum of £5 5s., claiming that this sum should be returned to them, it being a deposit made in respect of specifications which had been lent by defendants and returned by the plaintiffs with a *bonâ fide* tender for work required to be done in the connection with the Fender Valley sewerage scheme. A representative of the plaintiff firm stated that he had seen an advertisement asking for tenders for the work, and saying that specifications and quantities could be obtained at the office of Messrs. Beloe & Priest on payment of £5 5s., which would be returned on receipt of a *bonâ fide* tender and the specifications. He had called at the office of the firm named, and obtained the specifications and paid the £5 5s. as a deposit. He had tendered for the work and his tender had been accepted, but he had found out subsequently that the specifications contained a proviso with respect to sureties for carrying out the work, which he was unable to comply with. He therefore declined to sign the contract, and ultimately applied for the return of the deposit, but this was refused.

On defendants' behalf it was contended that the deposit had been forfeited by the action of the plaintiffs through their tender not being *bonâ fide*. They had seen the specifications containing the proviso respecting sureties, but had tendered for the work, though objecting to the conditions. For the plaintiffs it was further stated that they had arranged to obtain the guarantee of a society in place of the two sureties, but they found that no society would give the guarantee under such a clause as appeared in the contract. For the defence, it was also contended that it was usual to require deposits of sums of money, and that it was the custom of the profession to regard such sums as forfeited in cases such as that before the Court.

His Honour, Judge Shand, who heard the case, ruled that the plaintiffs had sent in a *bonâ fide* tender, but were unable to go through with it, owing to the clause as to sureties. The plaintiffs might have been negligent in not reading the specifications, and the defendants might have been put to expense thereby, for which they might have a claim for damages; but the defendants had not proved that the plaintiffs had not acted *bonâ-fide* in what they had done. He gave judgment for plaintiffs, with costs.

The case brought into clear light another of the difficulties connected with tendering. With the increasing extent and complexity of public works, involving the expenditure of large sums of money in their execution, it is but natural that some assurance should be sought on the part of public bodies, that the work, in a particular case, will be carried through to a satisfactory completion and not be left in an incomplete state. It must, however, impose a needless inconvenience, and one of a very unpleasant kind, upon manufacturers and contractors, if the provision of sureties, to be approved of by the consulting engineers or the public authorities for whom they may be acting, is to be made a condition of fitness to tender.

The position of a manufacturer who can only tender for carrying out public work on the condition that approved sureties are provided is so uncertain and undignified that many manufacturers would prefer to ignore contracts rather than incur the trouble and annoyance, and the probable expense of tendering in accordance with the conditions laid down. Sureties are not readily obtainable at the best, and firms who cannot obtain sureties most easily do not, as a rule, like to obtain them at all.

In commercial life, a simple reference as to the integrity and and reasonable, financial stability of a firm, suffices. A satisfactory reference to a bank usually suffices to enable business to proceed. In engineering works, apparently, it is to be otherwise, and the contractor is to be required to find sureties which will be acceptable to someone who may, or may not, possess the special knowledge for determining whether certain sureties are or are not sufficient, in a particular case, or, indeed, whether there is any need for sureties to be provided at all.

From the difficulty which contractors frequently have in obtaining payments on account of work done, where they have had to incur heavy current expenses on labour account, it would seem as if this new requirement with regard to sureties ought to be inverted, and that the employing party ought to give the contractor sureties for the prompt payment of instalments and of the final balance as these become due. The tendency of late years has been to crowd specifications with details, many of which, it must be admitted, require to be set out, and for which provisions require to be made. This has caused the work of tendering to be tedious and costly, and manufacturers and contractors have frequently cause for complaint, owing to the scanty consideration which they receive. The introduction into specifications of conditions which will give contractors needless trouble in tendering for work or in carrying out work under contract is to be deprecated.

It is common knowledge among manufacturers that some firms refrain from tendering for Government contracts owing to the heavy losses which have been caused through the onerous conditions which have had to be observed. The practice of being needlessly stringent and exacting in laying down conditions-of-tender is not of public advantage, and tends to check industrial enterprise. It will be well if these facts are borne in mind by those who have the drafting of such conditions. Manufacturers and contractors have a right to ask that when tendering for public work no greater labour or expense shall be required of them than the proper execution of the work demands.

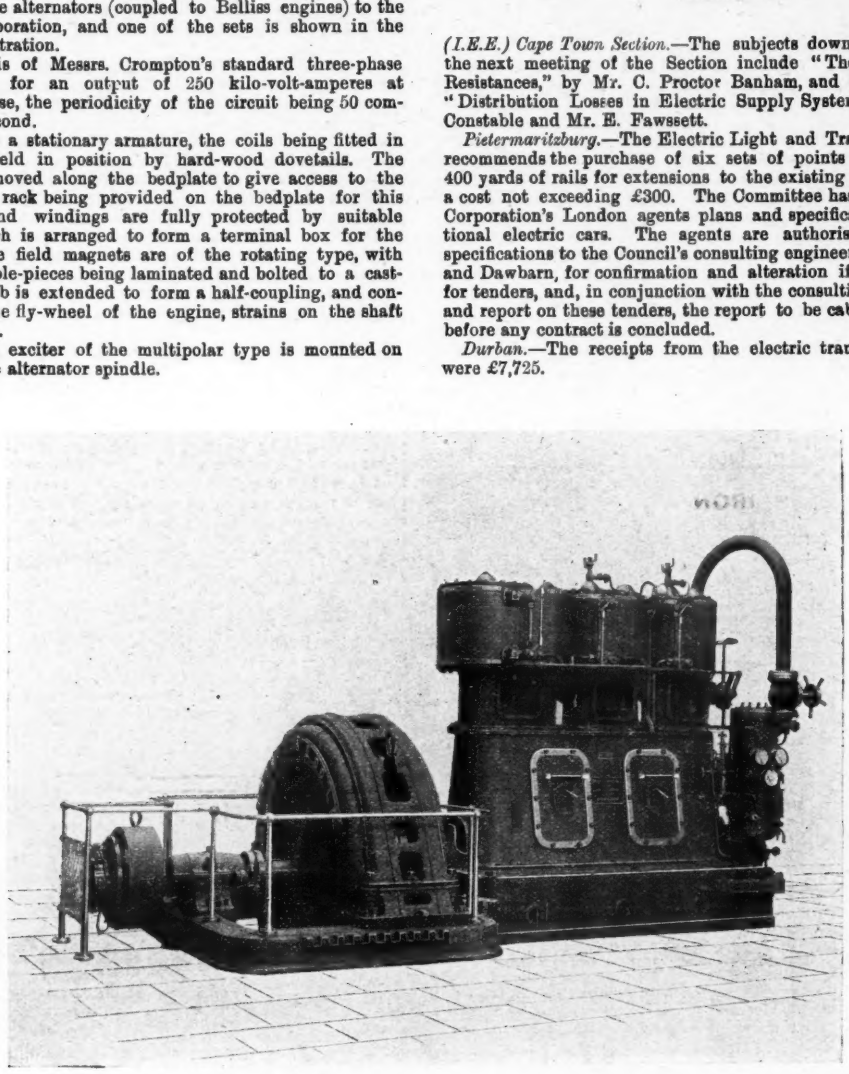
THREE-PHASE ALTERNATORS FOR BLOEMFONTEIN.

Messrs. Crompton & Co., Ltd., have recently supplied two 250-kw. three-phase alternators (coupled to Belliss engines) to the Bloemfontein Corporation, and one of the sets is shown in the accompanying illustration.

The alternator is of Messrs. Crompton's standard three-phase pattern, designed for an output of 250 kilo-volt-amperes at 2,200 volts per phase, the periodicity of the circuit being 50 complete cycles per second.

The machine has a stationary armature, the coils being fitted in open slots, and held in position by hard-wood dovetails. The armature can be moved along the bedplate to give access to the machine, a barring rack being provided on the bedplate for this purpose. The end windings are fully protected by suitable covers, one of which is arranged to form a terminal box for the main current. The field magnets are of the rotating type, with radial poles, the pole-pieces being laminated and bolted to a cast-steel hub. The hub is extended to form a half-coupling, and connected direct to the fly-wheel of the engine, strains on the shaft thus being avoided.

A direct-coupled exciter of the multipolar type is mounted on an extension of the alternator spindle.



Crompton-Belliss Three-Phase Alternator for Bloemfontein.

The engine is of Messrs. Belliss & Morcom's three-crank triple-expansion type, designed to work with 160 lbs. steam pressure at the stop valve, and capable of driving the generator either condensing or non-condensing. The speed of the combined set is 375 revolutions per minute.

These sets were built for the Bloemfontein Corporation, under the specification issued by Mr. Robert Hammond, and we are informed that at the official tests at Messrs. Belliss's works the machines in every way exceeded their guarantees, as shown in the table given below:—

		Specified.	Actual.
Temperature rise after 10 hours' run at full load	Armature	65° F.	39° F.
	Field	65° F.	18° F.
Steam consumption in lbs. per kw.-hour ...		26	24·4
Voltage drop from no load to full non-inductive load		7 %	4·5 %
Exciting watts		3,500	2,100

In addition the alternators were tested under severe conditions for parallel running, and gave great satisfaction to the consulting engineer. The governor trials also fully realised the expectations of the English builders.

Messrs. Crompton & Co. are now manufacturing a complete line of single and polyphase generators and motors, and have some important orders for this class of machinery in hand at the present time.

Newport (Mon.) Tramways.—The new Caerleon Road section of the Corporation electric tramways was opened on Tuesday last week for public traffic. The Electricity Committee has been discussing the question of acquiring additional cars.

SOUTH AFRICAN NOTES.

(From our Special Correspondent at Johannesburg.)

June 15th, 1903.

(I.E.E.) Cape Town Section.—The subjects down for discussion at the next meeting of the Section include "The Measurement of Resistances," by Mr. C. Proctor Banham, and also the paper on "Distribution Losses in Electric Supply Systems," by Mr. A. D. Constable and Mr. E. Fawssett.

Pietermaritzburg.—The Electric Light and Tramways Committee recommends the purchase of six sets of points and crossings, also 400 yards of rails for extensions to the existing permanent way, at a cost not exceeding £300. The Committee has forwarded to the Corporation's London agents plans and specifications for six additional electric cars. The agents are authorised to submit the specifications to the Council's consulting engineers, Messrs. Mordey and Dawbarn, for confirmation and alteration if necessary, to call for tenders, and, in conjunction with the consulting engineers, open and report on these tenders, the report to be cabled to the Council before any contract is concluded.

Durban.—The receipts from the electric tramways during May were £7,725.

Ladysmith.—A number of cable extensions were authorised at the last meeting. When these are completed, all the residential quarters of the town will be served. The Council has concluded a contract with Messrs. J. Hubert Davies & Spain for connections, at a cost of £1 9s. per property connected.

Natal.—The estimated expenditures on public works in Natal during 1903·4 are now published, and they provide for, amongst other works, an expenditure of £25,000 for extensions to the electric light and power plant at the harbour, and also £10,000 for electric Goliath crane and cables.

Johannesburg.—The Chamber of Trade is again on the war-path, and recently made inquiries into the reason why Johannesburg engineers had to pay Messrs. Mordey & Dawbarn a deposit of £10 for the specifications of material for the Johannesburg electric tramways, whilst at home only £3 3s. (extra copies at 5s. each), was charged. No definite arrangement was made with the consulting engineers on this point, it appears, they being left to charge what they considered desirable.

As mentioned a short time ago, the Johannesburg municipality proposed to acquire the property, plant, &c., of the Johannesburg Suburban Lighting Syndicate, which supplies current for lighting purposes to Bertramstown, a suburb of Johannesburg. This has now become an accomplished fact, the amount agreed upon being £2,100, and the municipality have authorised an immediate expenditure of £150 for the repair and general overhauling of the plant and equipment.

Troyville, Johannesburg.—A public meeting was held by the residents of this suburb (not Yeoville, as incorrectly reported last week, that suburb being supplied from the Rand Central Electric Works, Brakpan) last week to consider the question of lighting. It was eventually decided to accept an offer made some time ago by the Johannesburg municipality to light the township (1) on a two years' basis at 2s. per unit, or (2) on a three years' basis at 1s. 6d. per unit. The latter offer was decided upon, the township to supply a stand

50 ft. × 150 ft. on which to erect a temporary power station. An initial load of 2,470 lamps is expected.

A memorial has been presented to the Municipal Council from the residents in the north and north-east portions of the town on the question of electric tramway extensions. The ratepayers there are willing to be subjected to a special rate in order to have the system extended to that quarter. This memorial has been welcomed by the Council, and if powers can be obtained to levy this special rate, it is probable that all the outlying suburbs will be similarly dealt with.

Potchefstroom.—Consequent upon the apathy of the Government in dealing with the question of lighting in this old Rand capital, the inhabitants are taking matters into their own hands. As mentioned a few weeks ago, some of the large property owners are installing small lighting plants of their own, and the latest development is the formation of a company under the style of the Potchefstroom Consumers' Electric Light and Power Co., with a capital of £6,000 in £1 shares. The capital is already over-applied for, applications for current from the banks, hotels, military cantonment; numerous private consumers have been secured, and success seems assured. The company has already secured the necessary plant, and proposes to build its power station and stores on a stand in Lombard Street. Besides supplying current for light and power purposes, the company will do all the necessary installing and wiring, both in the town and on the neighbouring mines. A load of 800 to 1,000 16-c.p. lamps will be obtained from the block, on which the station will stand, alone.

A special meeting called by the Health Board to consider the question was postponed, information having been received from the Colonial Secretary that the Board had no power to deal with the matter.

THE ENGINEERING CONFERENCE.

HIGH-SPEED ELECTRIC TRACTION ON RAILWAYS.

By J. W. Jacomb-Hood, M.Inst.C.E.

(*Abstract.*)

The introduction of this subject would appear to be the duty of an electrical specialist, but inasmuch as the difficulties are to a large extent practical, the notes of a mere general practitioner in railway work may be acceptable.

The problem thus offered for discussion must first be defined. It must not be confounded with the problems in short distance and omnibus traffic that have alone been dealt with hitherto in this country, nor must existing practice under steam be allowed to limit the imagination as to the possibilities of service by electricity. As the question develops, it becomes clear in the first place that the existing adaptations of electricity to traction are not altogether suitable for general railway business, including economical high-speed services; and further, it is practically certain that the substitution of electricity for steam as a vehicle of power will of itself produce a change of general ideas and of general methods.

The term "high-speed electrical services" may be defined as representing frequent communication, without intermediate stops, between busy centres that are widely separated. The speed expected will certainly not be less than 60 miles an hour, and the cost of service per ton per mile must not be more than that of existing steam services. Means that are adopted for such high-speed services must be equally available for a modified stopping service, as well as for freight and shunting services, because it is inconceivable that railway companies will be tempted to electrify their lines for their high-speed services alone, and there must be no interference with the free use of lines by steam locomotives.

As some slight indication of the amount of work done by railways to-day, a diagram of actual services performed on a typical section of line, about 80 miles in length, on one of the busiest days of last year, is given. Assuming fixed average loads for the various classes of service, the total train-resistance has been calculated and plotted as a load curve. This will give a good general idea of the bulk of the business that electricity may some day be called upon to undertake. It will be seen that the peak of the load occurs before mid-day and involves a consumption of energy estimated at 661 millions of foot-pounds per minute, or very nearly the equivalent of 26,500 h.p. or 19,800 kw.

The high-speed trains, defined as those travelling at a speed of 40 miles an hour and over, are marked on the diagram on the wall by thick lines. This class of traffic is practically confined to the hours between 7 o'clock in the morning and 11 o'clock at night, and the load-curve is seen to be affected in consequence, but the proportion of high-speed trains to the total service throughout the 24 hours is only as 1 to 3.

It may be granted that conversion, in the case of services where electricity can with certainty compete economically with steam, will come; and that any new railways, built to connect large centres of traffic with a high-speed service, will, without much doubt, be equipped electrically; and the time will be spent to the best advantage if the leading features of an electrical equipment, that will meet the needs of high-speed and general services, are alone kept in view. Above all things it seems to be essential that as railway companies must, for the public benefit, continue to exchange rolling stock, the principles of any system must be acceptable to the whole body of railways before they can be adopted.

The ground for discussion being thus limited, the subject divides itself conveniently as follows:—(*a*) generation; (*b*) consumption; and (*c*) transmission, distribution, and collection of current.

Generation of Current.—Of all the vital questions connected with power stations, perhaps none is more important, although diverse opinions have been expressed, than the economical limits of size of steam or gas generating sets. In this country one or other would be, in nearly all cases, the only alternative. The possible positions of generating stations relative to the railway will frequently decide sizes; but assuming that the power capacity of stations will, on occasion, be determined chiefly by the limit of economy in generation, it is important that the subject of the most desirable maximum sizes of steam or gas sets for power stations should be well ventilated. After taking account of the increased cost and losses in extended transmission lines, reason would seem to dictate that the power stations should be as widely separated and as few in number as possible, to ensure a steadier load and a better load factor.

Power station practice is rapidly becoming standardised in detail, so that it can be foreseen with some confidence that moderate-speed engines, directly coupled to alternators generating in single or multiphase form at tensions as high as circumstances allow, will be used. As economy in every detail will have to be studied, it may be that gas engines in connection with a producer plant will prove the ultimate solution.

Consumption of Current.—Without invading the territory of the electrical engineer it is possible to bring forward one point of practical importance in connection with motor design. The practice of to-day seems to be almost universally in favour of a direct-current series-wound motor, with automatic field-regulation, which will run economically at any speed up to a maximum. On the other hand, there is the alternative, with some economical advantages to recommend it, of a system that involves the use of smaller high-tension currents, used in alternating single or multiphase motors, that are limited to one or, at most, two economical

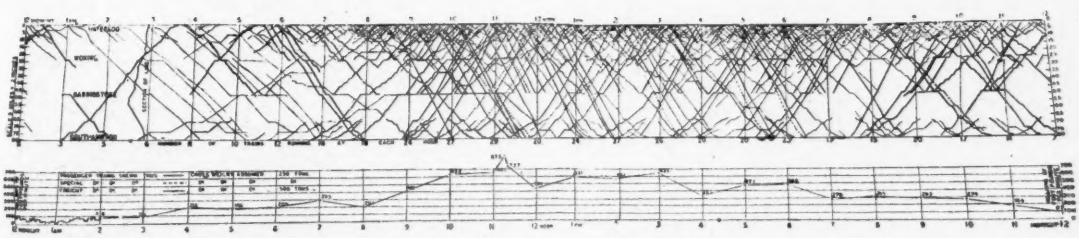


Diagram Showing Train Service and Load Curve, between Waterloo and Southampton, August 2nd, 1902.

speeds. Opinions differ widely as to the class of traffic for which invariable speeds are suited; and it must be confessed that it is extremely difficult to foresee the effect that invariable speed would have upon the conduct of general railway business. It is, however, tolerably clear that for any class of business variable speed is to be preferred.

Such points as the position and individual power of motors are all interesting, but inasmuch as motors arranged on a multiple-unit system to ensure minimum train weight, and maximum weight available for adhesion, will almost certainly be employed for high-speed railway service, whilst electric locomotives of high-power capacity for freight, shunting, and other general business, will also be required in the railway business of the future, time need not be employed in discussing them.

Transmission, Distribution and Collection of Current.—The principles of generation and consumption of current being determined, systems of transmission, distribution and collection must to a large extent follow. But it is here that the practical difficulties present themselves most formidably to the railway man. With all the complications due to dense traffic within a very limited construction gauge, and with the imperative need of safeguarding life and limb,

it is difficult to see how any system of distribution is to be carried out without serious objection.

Transmission perhaps has the fewest difficulties. In view of the urgent need for economy in first cost, it is to be hoped that bare overhead transmission lines will be used for carrying current at high voltage, rather than incur the heavier expense of cables.

So far as existing practice is a guide, a system of distribution to feed a third conductor-rail would appear to meet the needs of the case. There are in existence cases of railways where large currents are being collected from a third rail at speeds approaching 50 miles an hour, and experiments in this direction indicate that still larger currents than these can be taken at speeds up to 70 miles an hour. But the existence of a third rail at all, in any position, introduces trouble in the upkeep of the road and in other directions that are better avoided if possible. An overhead-conductor system would probably be less unwelcome to the maintenance engineer, and from some points of view it has advantages over any ground collecting system. But here, again, if the system is one of high-tension triphase current, the duplication of conductors presents another difficulty.

It will be interesting to watch the developments in the United States of the experiments about to be made with single-phase alternating currents, involving only one overhead conductor. The difficulties of collecting comparatively heavy currents from an overhead equipment appear to have been to some extent overcome on one of the North Italian railways.

Systems that have been advocated of collection from the primary conductor for use in a motor-generator on a locomotive seem attractive, and inasmuch as they would do away with sub-station difficulties and expenditure, the problem may thus be solved.

Inasmuch as pure accumulator systems, although they may be useful and economical for light branch-services, are not thought to have any promise for heavy general railway work, no further mention of them seems called for.

Discussion.*

Mr. W. E. Langdon, in the course of some supplementary remarks, emphasised his opinion as to the 6 ft. way being the correct place for the third rail, which he suggested should be on independent sleepers.

Mr. J. A. F. Aspinall (L. & Y. Ry.) referred to the position of the conductor rail, which had been under discussion by the railway companies, and all those north of the Thames had adopted a common arrangement. He pointed out that the load gauge was the limiting factor, which controlled the position selected. This gauge on the northern lines is 8 ft. 8 in. wide, and comes down to within 6 in. of the top of the track rail; it also only allows 4 in. side clearance from some platforms. They had placed the conductor rail 3 ft. 11½ in. from the centre of the track and 3 in. above the running rail, supported on the ends of sleepers. Protection boards would be provided where considered necessary, 8 in. apart, to allow for play in the collector shoe. The L. and Y. Railway Co. were adopting a fourth (negative conductor) rail in the centre of the track. The joints would be properly bonded, and it would be cross-bonded to the track rails, which would form the medium for current return from the motors and wheels in the ordinary way. The advantages would be found in permanent way construction, only one hole being necessary in the track rail, as compared with four in the usual way, and the sections could be easily removed when necessary. They would put the conductor rail in the 6 ft. way wherever possible. The proposal to roof in the conductor rail was not possible on account of the small space available.

Mr. Trotter referred to the section of the Metropolitan-District line recently opened to Harrow as a good example of English electrical railway work. There were in this case five rails to each track, two + and a — conductor rail being provided. There was a difficulty in using the 19½-in. distance for the conductor rail in the tubes, and a distance of 16 in. had been adopted at Harrow, similar to the tubes on account of inter-communication. He questioned whether it was worth putting an insulator under the return rail. The question of trespassers influenced the amount of protection to be given to the conductor rail, and it would be a necessity in goods yards. A difficulty in the case of a hood over the conductor rail was, he thought, that vertical movement of the shoe must be provided for. The arrangement adopted at Milan did not commend itself to him.

Mr. Poltheim took up the standpoint that the overhead conductor was far better than the third rail. In Italy there were two electrical trunk railways—the Mediterranean, about 40 miles long, worked on the L.T. system, and the Adriatic, 70 miles long, on the H.T. three-phase system, which had been running for two years, and had given such satisfaction to the Italian Government that four more electric locos. for use with the latter line, which was to be extended, were decided on. These locos. would exert 1,700 H.P. and draw 400 tons at speeds up to 60 miles an hour. In the three-phase system there was no difficulty in getting speed variations of 15, 30, 45 and 60 miles per hour without loss of efficiency, and he queried the practical necessity for finer regulation, which could, however, be obtained by using suitable resistances. The great feature, however, was the difference in cost of the two systems. In a length of 10 miles the cost of the 500-volt third-rail construction would be the same as for the three-phase overhead; but in a length of 30 miles the cost of the latter would be just half, and with 50 miles one third, that of the former. Instead of costing £8,000 per mile, it would cost £3,000. Referring to the supposition that more danger attended the use of H.T. overhead conductors, the Italian line had run for two years and no accidental death had occurred, and this he argued should incline the B. of T. to agree to such a scheme. He considered that railway engineers looked too much at their coal costs, which may amount to 2½d. in the total cost of 1s. per loco.-mile. Assuming the coal costs at 2½d. per loco.-mile, we should, if working electrically at ⅜d. per unit, have a corresponding figure of 4½d. per mile, but the average figure for loco. upkeep is, say, 2½d. to 3d. per mile, and with the Italian electric locos., only ½d., and in the latter case only one driver is necessary, a saving of 8d. per mile, so that we may put the saving at 3d. per mile over any system of 30 miles.

Mr. Ross (G.N. Railway) referred to the difficulty of adopting a common distance between the conductor and track rails, which he regarded as still unsolved. He preferred the conductor rail on standards separate from the sleepers. He was disappointed that the author had not touched on the carrying capacity of the trains; the corridor type as adopted in the tubes only hold 320 to 400, as compared with compartment trains of similar length holding from 650 to 800 passengers on the steam lines.

Mr. Gates, speaking for the Metropolitan Co., stated that they were compelled to adopt the 16 in. distance between the track and conductor rails, in common with other London underground railways. The fourth or return conductor rail would have to be 1½ in. above the track to allow for carrying the shoe (when used) over points and crossings. In the tunnels they were obliged to put the conductor rail outside the tracks.

Mr. Worthington (L & Y. Ry.) considered that everything electrical should be in the 6-ft. way, except in stations, where the conductors should be close to the platform, and the 6 ft. way left clear for patrolling. He did not consider the 19½-in. standard distance gave sufficient room for the plate-layers to carry out their track work, which was of greater importance in the open than in a tunnel. He disagreed with the suggestion for supporting the conductor rail separately from the track on account of the frequent alteration of levels, and the 1½-in. distance of a fourth rail above the track would be a very narrow margin.

Mr. Fletcher (N.E. Railway) gave some particulars of the proposed track construction for his company's Newcastle electrical routes.

Mr. Francis Fox warned his hearers of the dangers incurred by Continental companies in running at high speeds on unsuitable tracks. He considered that the running and permanent way departments should be one.

Gen. Webber, in the course of some remarks on H.T. distribution by means of overhead wires, pointed out that there were at present large numbers of telegraph and telephone wires at the side of the line. On the question of cost, however, he thought overhead transmission would have to be considered.

Prof. Smith considered that the magnitude of the currents to be dealt with would necessitate the use of third rails. The lack of speed variations was not a bar to the use of induction motors, as drivers could obtain any speed by coasting. There was no example of high-speed electric traction in Europe just now; all attempts in that direction depended more on the track than the locomotive. He did not think that by any possible rigidity of the road bed and track, speeds of 100 to 120 miles per hour would be attainable. He called attention to the vertical and horizontal oscillations of locomotives—the latter due to our system of guiding by two wheels and two rails; this lurching movement led to the possibility of derailment. The reasons for not running at high speeds on the Italian lines were the gradients, goods traffic, &c. He emphasised the improved coefficient of adhesion due to the uniform effort of the electric motor.

Mr. Cottrell referring to the position of the third or conductor rail, was convinced that the outside one is correct, and that if a fourth rail is put between the track rails, it should not be at a higher level, owing to the possibility of accident through loose chains hanging from the vehicles. They intended on the Liverpool Overhead Railway to adopt the standard position for the conductor rail, and hoped shortly to have an alliance with the L. and Y. Co. He drew attention to the increased acceleration which was obtainable on electrically-worked lines.

Major Cardew, in a written contribution, was able now to look at the problem of electrification from the point of view of the railway director. He considered that a standard system was essential, and drew attention to the enormous difficulties which would be met with in crowded junctions and at tunnels and bridges—they had also the Board of Trade to think about, and for the moment he was of opinion that the solution lies in accumulator locos. Referring to Mr. Jacomb-Hood's paper, where a maximum load of 26,000 H.P. was calculated for on the S.W. main line, he suggested that a suitable generating plant for such an output would consist of five sets, four capable of giving the maximum output, but three able to do so in emergency. Either gas or steam engines of any size were obtainable. He did not agree that the direct current series motor was efficient at any speed, and there was no necessity to assume that an alternating current motor was worse than a continuous one. There might be considerable difficulty in collecting current with a slipper at speeds of 60 miles an hour, the larger currents would involve the use of slippers having areas of upwards of 100 sq. in., and there might be serious results at crossings.

Mr. Trotter wished to disabuse Mr. Portheim and others of the idea that the Board of Trade wished in any way to hamper a practical scheme for overhead H.T. conductors, if submitted to it.

Mr. Jacomb-Hood, in replying, thought the discussion had been

* The discussions on Mr. Langdon's paper (see page 37 *ante*), and on that of Mr. Jacomb-Hood, were taken together.—Eds. Elec. Rev.

narrowed down to minor details—he emphasised the importance of the wider question as to whether the third rail should be used or not. The whole question turned on economy in working. Recent discussion on the sizes of generating units, had shown that it was questionable whether few large or several small ones would be more economical. The selection of the size and position of the generating station was a matter of great importance. He considered that a perfectly variable speed was necessary. Distribution difficulties would be encountered, but transmission under similar circumstances had been carried out on the Continent. In the matter of seating capacity, the S.W. Co. were running corridor trains which carried 10 per cent. more passengers than the older compartment trains of the same length. It was quite possible to carry as many people per square foot in the corridor as in the compartment carriage, and the public were undoubtedly in favour of a through passage at the present time. He questioned whether any company spent as much as 1s. per train-mile, and thought 9d. to 10d. more nearly correct; there would still, however, be a margin of economy in electrical working. He also pointed out that the railways South of the Thames had a narrower load-gauge than the Northern lines, and this had caused disagreement; but it was finally agreed by the Southern lines, who were in the minority, that where necessary girders and buildings should be altered as required, in order to conform to the standard.

Mr. LANGDON also replied briefly, and concluded that there was no general agreement of opinion as to the position of the conductor rail.

THE ELECTRICAL CONDUCTIVITY OF COPPER.

BY ROLLO APPLEYARD, A.M.INST.C.E.

(*Concluded from page* 4.)

Relation between Conductivity and log $\frac{D}{d}$.—It may be useful to set at rest another matter which concerns the subject. It is sometimes suggested that, since the conducting qualities are defined by the specified resistance per nautical mile of cable, it is superfluous to lay down limits for the conductivity of the copper. In favour of the omission of the conductivity clause from specifications, it is further argued that the manufacturer would gain the advantage of being left a free hand as to weight of copper, and that he would be constrained to keep his copper good, because any increase in the dimensions of the conductor would result in difficulties in regard to the specified limits of capacity and dielectric resistance. In order to discover to what extent this constraining influence would be effective in such a case, it is necessary to examine the change produced in $\log \frac{D}{d}$ for any core when a definite change is made in the percentage conductivity of the copper.

The weight, m, in pounds per yard of any cylinder of diameter d mils and of density Δ is—

$$m = 1{\cdot}0223\, d^2 \times \Delta \times 10^{-6} \qquad (6)$$

Differentiating this, we have—

$$\frac{\delta m}{\delta d} = 2{\cdot}0446 \times d \times \Delta \times 10^{-6} \qquad (7)$$

Since d is in mils, by putting $\delta d = 1$ we obtain an expression for the change in weight in pounds per yard corresponding to a change of 1 mil in the diameter, d, of any cylinder of density Δ. This result can be tabulated as follows :—

Solid cylinder of diameter d mils.	Density, Δ	Change in weight in pounds corresponding to 1 mil change in diameter d mils.	
		Per statute mile.	Per nautical mile.
Gutta-percha	1·0	0·00360 d	0·00415 d
Copper	8·9	0·03206 d	0·03692 d
India-rubber	1·3	0·00468 d	0·00540 d

If w_0 is the weight per nautical mile of a cylindrical copper conductor of 100 per cent. conductivity, and if w_1 is the weight of a conductor of the same resistance, length, and density, but of lower conductivity, say $(100 - x)$ we have—

$$\frac{100}{100 - x} = \frac{w_1}{w_0}$$

The change in *weight* due to change in conductivity is

$$\therefore (w_1 - w_0) = \frac{x\, w_0}{(100 - x)}.$$

To take a very ordinary weight, let $w_0 = 107$, and let $(100 - x) = 90$, so that $x = 10$, an extreme value for conductivity. Hence

$$w_1 - w_0 = 11{\cdot}89 \text{ lbs.} \qquad (8)$$

From this it is seen that the retrograde manufacturer who desired to use copper of 90 per cent. conductivity for that type of conductor, would have to add about 12 lbs. to the weight of every nautical mile; and as he would only be able to purchase the 90 per cent. conductivity copper at a very small fraction below the price of high-conductivity copper, he would really be out of pocket. Moreover, if the thickness of dielectric were specified and enforced, the added copper would lead to additional expense for dielectric. Let us now consider what would be the change produced in $\log \frac{D}{d}$ by a change of conductivity such as we have just contemplated. Corresponding to the diameters D and d mils, let W and w be the weights respectively of dielectric and copper, in lbs. per nautical mile. From equation (7) since 1 n.m. = 2,029 yards, putting $\Delta = 8{\cdot}9$ for copper, and w for m.

$$\frac{\delta w}{\delta d} = 2{\cdot}0446 \times 8{\cdot}9 \times 2{,}029 \times d \times 10^{-6}$$

$$\frac{\delta w}{\delta d} = 0{\cdot}03692\, d. \qquad (9)$$

Also we have, from equation (6) when $\Delta = 1$, and $m = \text{W}$,

$$\text{W} = 1{\cdot}0223\, (\text{D}^2 - d^2)\, 2{,}029 \times 10^{-6}.$$

If W is assumed constant, $\delta \text{W} = 0$,

$$\therefore \text{D} \cdot \delta \text{D} = d\, \delta d$$

$$\delta \text{D} = \frac{d}{\text{D}}\, \delta d = \frac{\delta w}{0{\cdot}03692\ \text{D}}, \qquad (9a)$$

from (9).

Now $$\log_{10} \frac{\text{D}}{d} = \log_{10} \text{D} - \log_{10} d$$

$$\delta \log_{10} \frac{\text{D}}{d} = \log_{10} \varepsilon \left(\frac{\delta \text{D}}{\text{D}} - \frac{\delta d}{d} \right).$$

From (9) and (9a)

$$\delta \log_{10} \frac{\text{D}}{d} = 0{\cdot}43429 \times \left(\frac{\delta w}{0{\cdot}03692\ \text{D}^2} - \frac{\delta w}{0{\cdot}03692\ d^2} \right). \qquad (10)$$

This is a general expression for the change in $\log \frac{D}{d}$ due to a change, δw, in the weight of copper per nautical mile when the weight of gutta-percha per nautical mile is constant. If $w = 107$, and W = 140, the corresponding diameters are $d = 76{\cdot}1$ and D = 270·7. Further, we have seen (equation 8), that, for this type of core, when the conductivity changes from 100 per cent. to 90 per cent., R being constant, $\delta w = 11{\cdot}89$.

$$\therefore \delta \log \frac{\text{D}}{d} = \frac{0{\cdot}43429 \times 11{\cdot}89}{0{\cdot}03692} \left(\frac{1}{270{\cdot}7^2} - \frac{1}{76{\cdot}1^2} \right)$$

$$= 0{\cdot}0019087 - 0{\cdot}024151 \qquad (10a)$$

$$= -\ 0{\cdot}022.$$

In the particular case here chosen, for a cylindrical conductor,

$$\log \frac{\text{D}}{d} = 0{\cdot}55108.$$

Hence, the change produced in $\log \frac{D}{d}$ for this type of core, when the conductivity changes from 100 per cent. to 90 per cent. is about −4 per cent. If D and not W is assumed constant, the first term in equation (10) and (10a) vanishes, and the corresponding change in $\log \frac{D}{d}$ is − 0·024. The restraining influence is therefore, in either case, fairly large; and in combination with the increased cost, should be effective. It is to the manufacturer rather than to the purchaser of cables that the conductivity test is directly of value. Nevertheless, indirectly, the conductivity clause probably ensures

to the purchaser, as well as to the manufacturer, that uniform, pure, copper is used; thus gaining to both the advantage of a flexible and generally good mechanical conductor.

Resistance in Terms of Weight and Conductivity per cent.—If the suggestions contained in this article as to the definition of standard 100 per cent. conductivity copper are accepted, and if it is agreed that the temperature correction factor between 60° F. and 75° F. is 0·002395 per 1° F., we may deduce that:—

1. The resistance of a copper wire of 100 per cent. conductivity, 1 *statute* mile in length, weighing 1 lb., is 861·044 standard ohms at 60° F. Its resistance at 75° F. is 891·977 standard ohms.

2. The resistance of a copper wire of 100 per cent. conductivity, 1 *nautical* mile in length, weighing 1 lb., is 1,144·36 standard ohms at 60° F. Its resistance at 75° F. is 1,185·4713 standard ohms.

This last result enables us to prepare a table from which the resistance of any copper conductor of given percentage conductivity can be calculated from its weight in lbs. per nautical mile. For, since, for a given length, resistance varies inversely as the weight, if the resistance for 1 lb.-n.m. is known, the resistance corresponding to any other weight w per n.m. is found by dividing the 1 lb.-n.m. resistance value by w.

In the following table the resistances are in standard ohms at 75° F.:—

Conductivity %	Resistance at 75° F. lb.-n.m.	Conductivity %	Resistance at 75° F. lb.-n.m.	Conductivity %	Resistance at 75° F. lb.-n.m.	Conductivity %	Resistance at 75° F. lb.-n.m.
105·0	1129·0	102·0	1162·2	99·0	1197·4	96·0	1234·9
104·9	1130·1	101·9	1163·4	98·9	1198·7	95·9	1236·2
104·8	1131·2	101·8	1164·5	98·8	1199·9	95·8	1237·4
104·7	1132·3	101·7	1165·7	98·7	1201·1	95·7	1238·7
104·6	1133·3	101·6	1166·8	98·6	1202·3	95·6	1240·0
104·5	1134·4	101·5	1168·0	98·5	1203·5	95·5	1241·3
104·4	1135·5	101·4	1169·1	98·4	1204·7	95·4	1242·6
104·3	1136·6	101·3	1170·3	98·3	1206·0	95·3	1243·9
104·2	1137·7	101·2	1171·4	98·2	1207·2	95·2	1245·2
104·1	1138·8	101·1	1172·6	98·1	1208·4	95·1	1246·5
104·0	1139·9	101·0	1173·7	98·0	1209·7	95·0	1247·9
103·9	1141·0	100·9	1174·9	97·9	1210·9	94·9	1249·2
103·8	1142·1	100·8	1176·2	97·8	1212·1	94·8	1250·5
103·7	1143·2	100·7	1177·2	97·7	1213·4	94·7	1251·8
103·6	1144·3	100·6	1178·4	97·6	1214·6	94·6	1253·1
103·5	1145·4	100·5	1179·6	97·5	1215·9	94·5	1254·5
103·4	1146·5	100·4	1180·7	97·4	1217·1	94·4	1255·8
103·3	1147·6	100·3	1181·9	97·3	1218·4	94·3	1257·1
103·2	1148·7	100·2	1183·1	97·2	1219·6	94·2	1258·5
103·1	1149·8	100·1	1184·3	97·1	1220·9	94·1	1259·8
103·0	1150·9	100·0	1185·5	97·0	1222·1	94·0	1261·1
102·9	1152·1	99·9	1186·7	96·9	1223·4	93·9	1262·5
102·8	1153·2	99·8	1187·9	96·8	1224·7	93·8	1263·8
102·7	1154·3	99·7	1189·0	96·7	1225·9	93·7	1265·2
102·6	1155·4	99·6	1190·2	96·6	1227·2	93·6	1266·5
102·5	1156·6	99·5	1191·4	96·5	1228·5	93·5	1267·9
102·4	1157·7	99·4	1192·6	96·4	1229·7	93·4	1269·2
102·3	1158·8	99·3	1193·8	96·3	1231·0	93·3	1270·6
102·2	1160·0	99·2	1195·0	96·2	1232·3	93·2	1272·0
102·1	1161·1	99·1	1196·2	96·1	1233·6	93·1	1273·3

For workshop test specimens of copper, it is convenient to note that upon the basis here suggested, the resistance, r, of 30 ft. of copper wire, n *inches* in diameter, of 100 per cent. conductivity, is—

$$r = \frac{0{\cdot}000305795}{n^2} \text{ standard ohm at } 60^\circ \text{ F.}$$

THE ERITH TRAMWAY SCHEME.

[BY OUR LEGAL CONTRIBUTOR.]

There are many valuable lessons to be learnt by a careful study of the evidence which is put before Parliament in support of a municipal tramway scheme. Those of the outside public who are interested in the progress of electric traction naturally direct their attention to the engineering problems which have to be overcome, and carefully study the evidence of the engineers upon whose advice, and with whose assistance, the scheme is brought within the range of practical politics. Again, the ratepayers of the district who hope to reap the benefit of a new and rapid system of locomotion naturally take a deep interest in the matter; and, assuming the undertaking is going to be a financial success, they look upon it, as ratepayers, with a favourable eye.

But do the ratepayers—and by that term we mean the persons who really pay the rates—always take for granted that every scheme promoted by the local authority is going to be successful? It is assumed, and as a little reflection will show it must necessarily be assumed, by the members of every Parliamentary Committee who have to consider a tramway scheme promoted by an urban or rural district council, that the ratepayers are the real promoters; and that, in putting forward and supporting the project, the council is merely acting as the mouthpiece of the inhabitants. If every dissentient ratepayer were entitled to come forward and state his view as to the financial prospects of the undertaking, the inquiry before a Private Bill Committee might be indefinitely prolonged.

But alas! the assumption that the District Council represents the ratepayers may be very well in theory, but it is hardly the case in practice. Times and again, when a municipal tramway scheme is brought before Parliament, many ratepayers wish to make objection, but cannot do so because they are too late. Too late, because they have relied upon random statements by members of the Council to the effect that the scheme is sure to pay and is bound to relieve the rates; and because they have not taken the trouble to inquire into the facts and examine the figures for themselves.

A careful study of the proceedings in the Erith Tramway Bill before the House of Commons reveals a state of things which we hope is of infrequent occurrence.

By this measure the Erith Urban District Council sought amongst other things to establish a system of electric tramways, the course of which lay, roughly speaking, between Erith and Woolwich. The total extent of the proposed lines was about 10 miles. Part of the route, namely, that which lies between Belvedere and Woolwich, was outside the district of the promoters, and outside the County of Kent. It was, in fact, the County of London and the district of the Woolwich Corporation; but the promoters had brought their scheme before Parliament without obtaining the consent of either of these bodies; and, as might have been expected, both these bodies appeared in opposition to the Bill in so far as it interfered with their interests. The measure was also opposed by the South-Eastern Railway on the ground of competition, and also because the promoters asked for powers to carry their tramlines over the railway, to abolish an existing level crossing, and to have it declared that the railway company should defray half the cost of the necessary bridge. The Bill was also opposed by certain influential frontagers in Belvedere.

We have said that the route of the proposed line lay between Woolwich and Erith; as a matter of fact, the promoters sought power to construct two parallel lines, one close to the South-Eastern Railway line and the other over a steep hill through Belvedere. It was also proposed to run a single line down Picardy Hill—a narrow road having very steep gradients and sharp curves, leading from Upper Belvedere to the Belvedere station.

The case for the promoters having been concluded, the Committee found that with the Picardy Hill route the gradients were too steep, and they, therefore, held the preamble not proved in so far as this line was concerned. With regard to the remaining lines, they expressed the view—subject to hearing the petitioners against the Bill—that the London County Council and Woolwich Corporation might come to some arrangement with the promoters, and that the South-Eastern Railway might be able to settle with the promoters the terms upon which the bridge should be built. At the conclusion of the whole case, however, the Committee declined to sanction any part of the line outside the Erith district without the consent of the London County Council. In, fact they gave the London County Council the first option to construct, and they also found that the preamble was not proved in so far as the greater part of the line from Belvedere to Woolwich was concerned. As the ostensible object of the Bill was to establish tramway communication between Woolwich and Erith, it will be seen that the scheme has practically failed in its entirety. The overhill route failed because that part which was authorised only extended halfway; the lower route fails because the portion authorised only extends to the boundary

of the County of London, and can go no further unless at some future time the County Council see fit to extend their existing Woolwich line to the Erith district, or give the Erith Council the right to carry out the work on their own account.

Some of the evidence put before the Committee in support of this scheme is of the greatest interest to those who are interested in municipal trading.

The estimated cost of the tramways when completed was £190,000. The present municipal debt amounts to £130,000. The rateable value of the district is about £153,000. The rates have increased from 6s. 8d. in the £ in 1899 to 8s. 4d. in the £ in 1902, and in addition to this there is a sewer rate upon certain classes of property of 7d. in the £.

According to the company's engineer it would require a ten-minute service and a return of 8d. per car-mile to make the trams pay. The present population of Erith is about 25,000. That of the entire district proposed to be served could not exceed 50,000. Yet, in the light of these facts, the Council were proposing to incur, by degrees, of course, an additional debt of £190,000. Further comment upon the facts and figures to which we have referred were almost unnecessary. Let us glance for a moment at the engineering aspect of the scheme. It was admitted by those called on behalf of the promoters that about 58 per cent. of the proposed lines if laid down would lie within the statutory limit of 9 ft. 6 in. from the curb. Yet it was argued that the public necessity for the trams was so great that the rights of frontagers and the claims of the wayfaring public should be altogether ignored. A search through a report of the proceedings fails to disclose the alleged public need.

One word as to the gradients. It appeared that on the Picardy Hill route, which, as we have seen was thrown out before the case for the petitioners against the Bill was heard, there were gradients ranging from 1 in 10 to 1 in 14. In the course of his cross-examination on behalf of the South-Eastern Railway Co., Sir Ralph Littler put the following question to one of the witnesses:—"Is it not the fact that there is a curve of 70 ft. radius in the middle of these steep places, a worse one than the one at the bottom of the hill, about halfway down?" And the answer was, "Yes. I remember that curve, because I considered what would happen in the event, which we hope will never occur, of a car coming off the track owing to trying to go round that curve at an excessive rate of speed, and as the thing is arranged at present the result, though it might be very serious, would be somewhat mitigated by the fact that the people would be thrown into an orchard!"

This answer, as was no doubt intended by the eminent witness who gave it, created a laugh, but the study of such evidence, and there was much of a similar kind laid before the Committee, ought to have a lasting effect upon the minds of those who are inclined to look upon every municipal scheme with a favourable eye. Is it surprising that a Committee of the House of Commons have seen fit to knock the bottom out of a scheme in favour of which the very promoters were hardly able to give any satisfactory evidence?

We congratulate the ratepayers of the Erith Urban District that through the kind offices of the petitioners against the Bill, their representatives on the Council have been prevented from rushing headlong into further debt; but at the same time we sympathise with them in having to defray the costs of an attempt to obtain Parliamentary powers for tramways for which the promoters were unable to show there was any public need.

HOLIDAY TRAFFIC ON TRAMWAYS.

By L. E. HARVEY, A.M.I.E.E.

The question of holiday traffic on tramways is just now, during these summer months, being prominently brought before the notice of tramway managers and officials who have to cope with it.

Easter Monday, Whitsun Monday and Tuesday, and August Bank Holiday are probably the four days in the year on which there is the heaviest service, and to these must be added perhaps a dozen exceptionally fine Saturdays and Sundays, and in the case of most towns, perhaps, three other days in the year upon which there may be some special event, such as races, sports or cricket matches.

Taking the case of Bank holidays, we find that the rush commences fairly early in the day, and increases rapidly till about the middle of the afternoon; then, if at all, there is a slight lull, and after that the returning rush comes on, and lasts, perhaps, till midnight, or even later. The service, most probably, is not commenced so early as on ordinary weekdays, but if we take the hours as 7 a.m. till 1 a.m., we have 18 hours' exceptionally heavy traffic. This will mean two shifts of drivers and conductors, or, at any rate, of drivers, though the conductors might possibly work the long shift. All the men would have to be paid double time for these Bank holidays.

In the case of fine week-ends and special days, the traffic will not compare with Bank holidays, but will still be exceptionally heavy. On Saturdays especially there will be a longer day's run, as the cars are started at the ordinary early hours, and continue just as late, making perhaps, a 21-hour day. This will mean longer shifts for the men, though they will not be paid double time throughout.

Coming now to the provision of extra cars for these holidays. In most towns the number of cars in regular use on working days will not exceed, perhaps, 60 or 70 per cent. of the total number in stock, leaving 30 or 40 per cent. as stand-bys (many of which are undergoing repairs, overhauling and painting) for Saturday afternoons and other extra traffic. The exact percentages are, of course, dependent on the local conditions of each separate system, and these can only be arrived at with very careful judgment and close observation of the needs of the districts served.

And here comes the most important question, how far it pays to keep a certain number of cars especially for holiday and week-end traffic, which are idle, or practically so, for the rest of the year. It is a matter that requires considerable calculation and foresight. Probably it is better to err on the side of having too few than too many spares. The chief items of expense of these extra cars run on special occasions, without taking into account the cost of current used, are, extra time to drivers, &c., cost of car-shed housing, and general upkeep during the greater part of the year when they are not in use. The profits derived from these extra cars must represent a fairly large percentage of their capital cost, plus depreciation. Undoubtedly it pays to provide a certain number of extra cars, but exactly how far to carry the point is, as has been said, a very delicate matter, and requires great judgment on the part of the responsible person.

Then, again, we have the provision of extra drivers and conductors for these cars. Perhaps the best plan, and certainly the most obvious one, is to take a certain number of the regular conductors and train them as drivers, paying them, of course, a slightly higher wage than ordinary conductors during the rest of the year. Their places as conductors and the extra conductors on the special cars can then usually be filled by pretty well all the men about the sheds, such as cleaners, fitters, &c. There is not very much to be learnt by a conductor, and these odd men could have a certain amount of instruction; and even if they do miss a few more fares than a "regular," the chances of pilfering are reduced to a minimum, and they do not need to have a particularly good knowledge of each route and its special stopping places.

Of course every available car should be got ready before a Bank holiday, none should be in the paint shop, or undergoing slight repairs, &c., but at the same time every car that goes out must be in perfectly good condition, especially with regard to its brakes, controller, motor and trolley connections, and particular attention should be paid to the trolley head and wheel, as nothing is more vexatious on such an occasion than damage to the overhead work caused by a trolley jumping, and putting, perhaps, a whole route out of gear for some hours. It is a point that is very often overlooked in the hurry of getting cars out, and if a bad wheel happens to be noticed just at the last moment, the remark is heard "let it go and chance it!"

As to handling the people starting from termini, the queue system is certainly the best, but to carry this out with any degree of success requires the co-operation of the police, and the presence of a traffic official who can, by telephone or otherwise, call out extra cars from the sheds as required. The best arrangement is to have a continuous service of cars starting at short intervals, if the route is a suitable one. In the case of a hilly route these intervals between cars should be as long as possible, because if the cars are sent off in batches of say three or four, and these get to the bottom of a dip in the road at the same time as three or four cars coming in the opposite direction, you get the case of six or eight cars going uphill at the same time, and the result is that the pace is either very "crawlly" or the cutters are knocked out at the station. If this latter happens, of course all the cars are stopped while the cutters are being replaced, and then it is an invariable rule for all the drivers to simultaneously put their controllers full on at once, and the cutters again come out. Of course, with single-track work with loops, this is to a large extent unavoidable, but in this case not more than two cars should be despatched together.

A word about the generating station. If it is a combined one for traction and lighting, then a Bank holiday is not such a strain, as there will be a very small lighting load (due to shops being shut) and nearly every unit can be put on traction. That is, of course, if the systems are adapted to each other. For this to be so requires the lighting system to be a three-wire one at 200 to 230 volts, and the machines so designed that when they are changed from shunt to compound the voltage is raised to the traction pressure. In the case of a separate traction station, we have to rely on the spare plant to take all the extra load. And here again comes the question of providing additional plant for special occasions. If extra cars are provided, then there must be sufficient standby generating plant to cope with them. Probably in a traction station every available unit will be working at top load, and if anything breaks down it is a case of shutting down the lot. Every care should, therefore, be taken to thoroughly overhaul the engines, pumps and condensers, &c., some days previously. The generating cost on these occasions will be slightly greater, as engine drivers and firemen will expect double pay, and probably also, they will take a lot of looking after owing to their propensity to join in the general festivities before they come on shift.

In conclusion, it may be said that these holidays cause an enormous amount of worry and anxiety to those responsible, but if the traffic is properly "worked," a good, and generally much needed, fillip is given to the financial side of the undertaking.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

13,906. "Improvements in billiard chalk-holders and suspending devices therefor, such suspending devices also being applicable to electric light fittings and the like." T. J. Watkins. June 22nd.

13,911. "Improvements in automatic electric circuit breakers." A. B. Reynders, C. B. Auel, R. D. T. Alexander and J. R. Spurrier. June 22nd.

13,916. "An improved process for rendering marble aseptic, and for increasing its properties of electrical insulation." H. H. Lake. (Chemisch-Technische Fabrik Dr. Alb. R. W. Brand & Co., G. m. b. H., Germany.) June 22nd.

13,937. "Therapeutic electro-magnetic and Faradic healer." F. C. Fisher. June 23rd.

13,945. "An improved electrical motor starting switch." U. Horsfall, J. Crowther and T. C. Wild, all trading as the "The New Contact Controller Co." June 23rd.

13,970. "Improvements in indicator-jacks for telephone switchboards." W. Aitken. June 23rd.

13,983. "Improvements in induction coils." J. Splitdorf. (Date applied for under Patents Act, 1901, April 8th, 1903, being date of application in United States.) June 23rd. (Complete.)

13,992. "An improved electric sparking plug for internal combustion engines." H. Hirst and H. J. Coates. June 23rd.

14,021. "Improvements in galvanic batteries." P. Brandt. June 23rd. Complete.)

14,028. "Improved process and apparatus for the production of metals of the alkali group, and alkalies by electrolysis." E. A. Ashcroft. June 23rd.

14,062. "An improved electrical cash checking machine." E. Guess. June 24th.

14,079. "Improvements in controlling systems for electric motors." The British Westinghouse Electric and Manufacturing Co., Ltd. (The Westinghouse Electric and Manufacturing Co., United States.) June 24th.

14,106. "Improvements in electrically operated ventilators." H. J. Haddan. (The Bergmann-Electricitäts Werke Aktiengesellschaft, Germany.) June 24th. Complete.)

14,107. "Improvements in and relating to electrically operated lifts." A. H. Adams and J. T. Moulds. June 24th.

14,163. "Improvements in apparatus for electric lighting." F. W. Le Tall. The Cooper-Hewitt Electric Co, United States.) June 25th.

14,164. "Improvements in gas or vapour electric apparatus." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) June 25th.

14,165. "Improvements in gas or vapour electric apparatus." F. W. Le Tall. (The Cooper-Hewitt Electric Co, United States.) June 25th.

14,166. "Improvements relating to gas or vapour electric apparatus." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) June 25th.

14,167. "Improvements in systems of electrical distribution." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) June 25th.

14,168. "Improvements in systems of electrical distribution." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) June 25th.

14,169. "Improvements in systems of electrical distribution." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) June 25th.

14,170. "Improvements in starting means for gas or vapour electric apparatus." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) June 25th.

14,171. "Improvements relating to gas or vapour electric apparatus." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) June 25th.

14,172. "Improvements in systems of electrical distribution." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) June 25th.

14,173. "Improvements relating to breaking and controlling electric circuits." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) June 25th.

14,174. "Improvements in systems of electrical distribution." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) June 25th.

14,175. "Improvements in gas or vapour electric apparatus." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) June 25th.

14,176. "Improvements in electric heaters or rheostats." F. C. Newell. (Date applied for under Patents Act, 1901, June 27th, 1902, being date of application in United States.) June 25th. (Complete.)

14,190. "Improvements relating to wireless telegraphy." S. G. Brown. June 25th.

14,204. "Improvements in or relating to telephone systems with central battery." G. M. T. Piltx. June 26th. (Complete.)

14,211. "Improved electric switch and circuit breaker." Veritys, Ltd., and E. J. Selby. June 27th.

14,219. "Internal enamelling of electroplated and silver hollow-ware articles." W. Kenyon and S. Hobson. June 27th.

14,247. "Improvements in electric resistances." H. V. Kramer. June 27th.

14,269. "Improvements relating to electrical fire alarms and other electrical signalling systems—telegraphy, telephony, wireless telegraphy and the like." E. G. Pulford. June 27th.

14,286. "Improvements in cases or covers for the protection of electrical apparatus." C. M. Dorman and R. A. Smith. June 27th. (Complete.)

14,295. "Improvements in electro-magnets, especially applicable for use in electro-magnetic separators." The Edison Ore-Milling Syndicate, Ltd. (T. A. Edison, United States.) June 27th.

14,304. "Improvement in sparking plugs for electric ignition of gas or oil engines." J. B. Jarvis. June 27th.

14,309. "An electric roasting oven." G. E. Dutertre and M. F. H. Nodet. June 27th.

14,318. "Improvements in apparatus for regulating the supply of current in electric mains." H. W. Butler. June 27th.

14,363. "Improvements in telephone call recording systems." H. H. Lake. (The Automatic Telephone Meter Co., United States.) June 27th.

14,373. "An improvement relating to the illumination of railway or like signals by electric incandescence lamps." Siemens Bros. & Co., Ltd., and L. M. G. Ferreira. June 27th. (Complete.)

14,375. "Improvements in switches for use in connection with selective electric signalling apparatus." C. M. Jacobs and A. H. Nicholson. June 27th.

PUBLISHED SPECIFICATIONS, 1902.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

452. "An improvement in electrical ignition apparatus for internal combustion engines." C. D. Abel. (Communicated.) Dated January 7th.

2,520. "Improved means of connecting and disconnecting electric mains or cables in street boxes." S. E. Britton. Dated January 31st.

2,521. "An improved disconnecting box for electric mains with means for rendering same gas and waterproof." S. E. Britton. Dated January 31st.

2,736. "Improved magneto-electric ignition apparatus for gas engines." G. Honold. Dated February 3rd.

2,828. "Improvements in rail bonds or connecting strips for electric railways." M. T. Whiton. Dated February 4th.

3,142. "Improvements in or relating to safety device for electric overhead conductors." A. J. Boult. Dated February 7th.

3,153. "An electro-magnetically-operated switch for opening and closing an electrical circuit." C E. G. Gilbert. Dated February 7th.

3,163. "Improvements relating to secondary circuits of alternating currents." R. Grisson. Dated February 7th.

3,336. "Improvements in electrical resistances." R. Hopfelt. Dated February 10th.

3,748. "Improvements in or relating to alternate-current distribution for railways and tramways." W. M. Mordey. Dated February 13th.

22,751. "Improvements relating to electric illuminating devices, chiefly designed for use in connection with signs and the like on tramway lines." H. H. Lake. (Reversible Electric Car Co, U.S.A.) Dated October 18th.

23,784. "Improved grinding device for the trolley wheels of electrically-driven tram and like cars." J. A. Miller. Dated October 30th.

24,260. "Improvements in or relating to trolleys for electric railways with overhead conductors." E. Lemange. Dated November 5th.

26,552. "Improvements in selective signalling by electro-magnetic waves." R. A. Fessenden. Dated December 2nd.

27,802. "An improved manufacture of porcelain insulators and other hollow earthenware articles and apparatus therefor." F. M. Loche. Dated December 16th.

28,288. "Improvements in electrical resistance coils." H. P. Davis. Dated December 22nd.

28,340. "Improvements in railway switches and in means for operating same." C. A. Day. Dated December 23rd. (Communicated.)

28,808. "Improvements in connection with galvanic batteries." The Halsey Electric Generator Co., Ltd. Dated December 30th. (Communicated.)